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A DYNAMIC COMPUTER MODEL TO EXAMINE SELECTED EFFECTS OF 304XX CAREER FIELD CONSOLIDATION

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In the future, it may be desirable and feasible to consolidate Air Force career fields within groups of career fields that perform similar tasks. This is particularly true within electronics maintenance career fields where advances in technology, notably integrated circuits, are providing more common ground between the individual career specialties. This research develops a dynamic computer model to predict the effect of a consolidation on assignments, manning, and numbers of personnel to be trained. A particular case of consolidating four existing Air Force communications maintenance career fields is investigated in depth through the computer model. The model uses the SLAM simulation language and was run on the CDC Cyber 6600. Conceptually, the model views the assignments process as a continuous flow of personnel to and from overseas. The process of training personnel from the individual career fields into the consolidated career field is modeled as a network activity. The model shows the interactions between training rates, assignments and manpower levels that are present in a consolidation.

LSSR 66-82

A DYNAMIC COMPUTER MODEL TO EXAMINE SELECTED EFFECTS OF 304XX CAREER FIELD CONSOLIDATION

A Thesis

Presented to the faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

in Partial Fulfillment of the requirements for the

Degree of Master of Science in Logistics Management

By

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CHAPTER I

INTRODUCTION

Purpose of the Study

This research will examine a proposed consolidation of four Air Force enlisted career fields to determine the effect that the consolidation would have on rotation between assignments overseas and in the continental United States (CONUS). The career fields to be studied are Air Force Specialty Code (AFSC) 304X0, Radio Relay Maintenance; AFSC 304X4, Ground Radio Maintenance; AFSC 304X5, Television Maintenance; and AFSC 304X6, Satellite Communications Maintenance. The detailed form of the consolidation, as proposed by Air Force Communications Command (AFCC) will be presented in the Background Section.

Background

Because of its mission of providing worldwide communications, AFCC finds its personnel stationed at more locations worldwide than any other major Air Force Command. Further, because most stateside communications are contracted from commercial companies, some AFCC maintenance career fields have few manpower authorizations to rotate into on return to CONUS. Personnel in these career fields spend minimal time stateside and return overseas. This situation is not unique to AFCC, but is particularly severe within the command.

A career field with the rotation pattern described above is said to have an Unfavorable Rotation Index (URI), or CONUS/Oversea imbalance. A Conus/Oversea imbalance AFSC is a specialty

> . . . for which there are not enough CONUS authorizations to support oversea requirements, and ensure airmen a reasonable continental United States (CONUS) residency between overseas tours [32:p.1-1].

A more quantitative definition is available for URI. A URI exists when any or all of the following three criteria are met. First, an individual remaining in a career field for twenty years would spend over eight years overseas. Second, an individual remaining in a career field for twenty years would serve more than two remote tours. Third, an individual would spend less than twelve months in CONUS between overseas tours.

These cirteria are measured at the Air Force Military Personnel Center by a computer and mathematical model called the McIntyre Model. The output of the McIntyre model is essentially a listing of AFSCs and their performance on the three criteria (1:p.1-2). Thus, management personnel can identify AFSCs with a URI.

The Air Force concern with the CONUS/Oversea Imbalance problem is tied to morale problems and low retention rates. As a matter of fact, the rotation index is a specific factor in Air Force retention models used to project accession requirements (2).

Individuals in a career field with a high probability of a remote or overseas tour are more likely to leave the Air Force or to cross train. In either case the result is an increased training requirement and a loss of experience from the career field involved.

The management actions available to address a URI are limited. For instance, airmen who have been awarded two or more AFSCs, one of which is imbalanced, can only be assigned overseas in the imbalanced AFSC. The intent is to prevent an AFSC with a favorable rotation index from using a manpower resource of an AFSC with a critical need for personnel overseas (31:82).

A second available action is to

> . . . retrain airmen returning from overseas who have only CONUS imbalance AFSCs, for which CONUS assignments do not exist, into CONUS-usable AFSCs, and to maintain identification of their dual qualification [32:p.1-2].

Effectively, this says that personnel are retrained so that there is a place to put them to work while in CONUS. One possible drawback of this concept is the added training cost. A second is the negative effect on proficiency and morale due to moving in and out of a career field.

Neither of these two actions alleviate the rotation imbalance. They are palliative measures. This research examines an initiative undertaken by AFCC which has the potential to effectively address the problem for the four career fields listed above. In its simplest form the initiative will combine career fields that have a mix of favorable and unfavorable rotation patterns to attempt to produce an overall favorable rotation pattern.

Although a URI problem may be an incentive to consolidate career fields, the practicality of doing so certainly has to be evaluated. This is accomplished within the Air Force by examining the degree of commonality between career fields in terms of their equipment, their theoretical knowledge requirements, and their task requirements (30:1).

The increasing appearance of integrated circuits and modular design in Air Force electronics are factors that may make future consolidations of various electronics maintenance specialties possible. In fact, serious consideration is being given to future consolidations in the Ground Radar and Navigational Aids maintenance specialties, the Teletype and Cryptographic maintenance specialties, and Outside Plant and Base Wire maintenance specialties at AFCC (17:1-3). All of these possibilities look to a future where technological advances reduce the need for specialization and experience.

In addition to providing a more balanced manpower base to solve URI type problems, consolidating related career fields offers other potential advantages at both macro and micro management levels. At the micro or unit level, more generalized technicians will infuse competence in maintaining a wide range of equipment. Most work centers at the unit level are small shops where a temporary manpower shortage is hard felt. Combining specialties will allow the "law of averages" to smooth out the on-hand technical competence level.

At the macro level, consolidations, such as proposed for 304XX, will allow a personnel problem like URI to be forcefully addressed. In the actual 304XX case, consolidations would reduce an assignment system inequity--differing probabilities of overseas and remote assignments within related career fields.

The a priori feasibility of improving the 304X0 URI through a consolidation can be established by examining Table 1 which presents authorizations at the five and seven skill levels[1] in the four AFSCs.

The ratios, shown in the far right column, can be interpreted as follows: ratios greater than 1.5:1 are considered favorable; ratios less than 1.5:1 are considered unfavorable. This is a somewhat arbitrary division based on the criteria contained in the McIntyre model (1:p.1-2). However, it is intuitively clear that a large ratio of

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[1]The seven level personnel are the more experienced technicians in the career field. Five levels become seven levels through promotion in rank and skill upgrade.

CONUS to overseas authorizations is desirable, because it means personnel will spend a smaller portion of their career overseas.

As shown, the 304X4 and 304X5 AFSCs have a favorable ratio of CONUS to overseas authorizations. If their authorizations were added to those of the other two AFSCs, it would tend to improve the 304X0 and 304X6 ratio of CONUS to overseas authorizations. The straightforward averaging given in Table 1 shows that the 304X0 career field would go from a ratio of .75:1 to 1.38:1.

TABLE 1

CURRENT FIVE AND SEVEN LEVEL AUTHORIZATIONS

AFSC	AUTHORIZATIONS			(CONUS/OVERSEAS)
	CONUS	OVERSEAS		
		TOTAL	# REMOTE	
304X0	962	1272	180	.75
304X4	2380	1375	38	1.73
304X5	406	97	1	4.19
304X6	282	187	29	1.51
TOTALS	4030	2931	248	AVG: 1.38

In the context of the McIntyre model criteria, this would mean that on average, individuals in AFSC 304X0 would experience .71 remote tours instead of 1.61 remote tours in a twenty year career. Similarly, an individual who served for twenty years would spend 8.4 years overseas as compared to 11.4 years overseas. This potential improvement would be due to consolidation.

The consolidation as actually proposed is not, however, a straightforward merger of the four AFSCs as depicted in Table 1. Only personnel with over four years in service would be eligible for the consolidated AFSC. Not every eligible person would be selected. Those selected into the consolidated career field would be eligible to fill any assignment within AFSCs 304X0, 304X4, 304X5, and 304X6 at the appropriate skill level (five or seven). This leads to a more detailed discussion of the rationale for the particular form of the proposed consolidation.

An idea paper (34:1-3) favorably considered at AFCC essentially stated that the first term reenlistment rate is too low to warrant investment in the increased training needed to produce a master technician. Producing a generalist, as opposed to the specialists the Air Force now has, requires more training. The cost is not justified given low first term retention rates. Thus, the paper concluded that it is more cost effective to invest in advanced training for individuals who have made a career commitment.

The idea paper goes on to cite other advantages of selection after a first reenlistment. The principal advantages are prestige and experience. Four years of practical or on-the-job experience produces a technician with greater knowledge going into an advanced technical training school. Since selection of eligibles is not automatic, prestige of selection becomes an additional factor and presumably some competition for available quotas will exist.

To summarize then, the pertinent background facts are these:

1. A URI problem exists and a solution has been proposed for the four AFSCs being considered. The proposed solution has intrinsic merits apart from attacking the URI problem.

2. Under the proposal, personnel with over four years in service would be eligible to train into a consolidated AFSC. A special technical school would be created for this purpose.

3. Not all eligibles would be selected--only a number sufficient to create and sustain a particular force level in the consolidated AFSC.

4. Personnel in the consolidated AFSC would be eligible to fill any existing 304X0, 304X4, 304X5, or 304X6 assignment of appropriate skill level.

Justification for Study

This topic was first discovered in the Air University "Compendium of Suggested Research Topics". Subsequent review of official correspondence revealed the consolidation proposal to be an ongoing management initiative within

Air Force Communications Command. The actual consolidation that is central to this research would affect the career progression of career fields with approximately 7,000 personnel. The consolidation has the potential to alleviate an unsatisfactory assignment pattern that affects approximately 3,000 personnel as shown in Table 1.

Furthermore, the ideas and techniques to support this research effort have a general applicability to any similar type consolidations. As new equipment comes into the Air Force inventory, technology will make it feasible to merge other career specialties. This research proposes to develop quantitative tools to predict the effect of such mergers on assignment patterns. It would, therefore, have a general applicability beyond this specific case.

Finally, if this consolidation is to be viewed as a possible solution to a URI problem, this study provides an advance idea of its potential effectiveness. The actual consolidation may not take place for some time. To hold it out as a solution to the URI problem may be premature and reduce the impetus for other management effort.

Problem Statement

Currently, no methodology exists for evaluating the impact of AFSC consolidations on overseas rotation patterns. Even if it is granted consolidation would improve URIs, this lack of an appropriate methodology limits management's ability to predict by how much or under what circumstances.

Research Objective

The overall research objective is to quantitatively predict the effect the proposed consolidation will have on overseas rotation patterns. The research can be broadly divided into two segments timewise--the steady state and transitory periods. A steady state can be roughly defined as the time period after the consolidated AFSC first reaches its targeted manpower levels. The transitory period encompasses all time between beginning consolidation and reaching steady state--essentially the period while manpower levels are building up.

A diagram can best illustrate the division into steady state and transitory periods. Figure 1 shows a

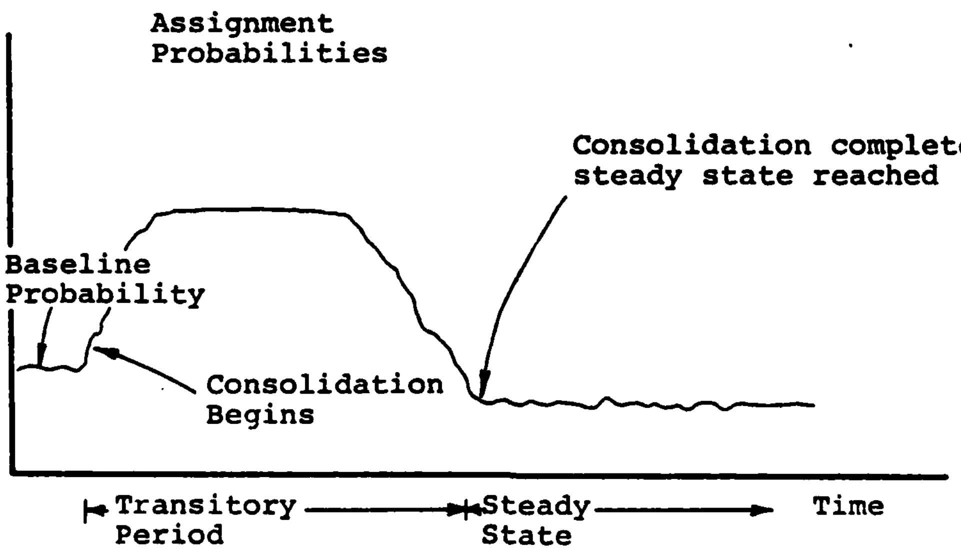

Figure 1

Hypothetical Graph of Assignment Probability Versus Time hypothetical graph of assignment probabilities[2] versus time. As illustrated, the transitory period is the time between beginning consolidation and reaching an equilibrium value of assignment probability.

Transitory Period

The analysis of the transitory period is more qualitative than that of the steady state. The focus is on examining the effect of the training pipeline on average assignment probabilities. An extreme example can best illustrate the general point.

A decision to train 1,000 personnel in a three month period would have a significant impact on average assignment probabilities. Those not in the training program would have to fill all assignments during that period. On the other hand, after the brief three month period, 1,000 personnel would be available again for overseas assignments.

Thus the transitory period examines the intermediate consequences of a consolidation. Does the assignment probability change dramatically or insignificantly? Does the consolidation have an immediate or delayed effect? These are the types of questions to be answered for the

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[2]Assignment probability is defined as the number of assignments in a given month divided by the number of personnel in CONUS available to fill the assignments. This will be discussed in more detail later.

transitory period.

Steady State Period

The analysis of the steady state period is principally concerned with measuring the change in overseas rotation patterns caused by creating the consolidated AFSC. Another area of interest is to estimate the training throughput rate to sustain a given manpower level in the consolidated AFSC. Both of the steady state areas of interest are briefly considered below and developed more fully in Chapter III.

Overseas rotation patterns are analyzed in terms of the changes in average overseas assignment probabilities before and after consolidation. These probabilities are expressed as the ratio of the number of overseas assignments in a given month divided by the number of personnel in CONUS available to fill the assignments. This effect is measured separately for accompanied and remote assignments.

Training throughput rate--the second steady state interest area--is examined in two ways. The first is in terms of an aggregate throughput requirement. This is simply the total average number of personnel to be trained into the consolidated AFSC to keep it at its targeted manpower level. The second analysis is a qualitative description of how the training requirement is divided between five and seven skill level personnel.

Research Questions

The questions developed to support the overall objective of this research can be categorized by the time period to which they apply.

Steady State Period

Research Question 1: How would various manpower levels in the consolidated AFSC affect the assignment probabilities in the four original AFSCs and the consolidated AFSC itself?

Research Question 2: What is the training throughput rate necessary to sustain a given consolidated AFSC manpower level?

Transitory Period

Research Question 3: How would various training throughput rates and manpower levels affect assignment probabilities in the original AFSCs during the transitory period?

Scope and Limitations of the Study

A rational decision on how or whether to implement a consolidation of AFSCs would involve many factors. It is not possible in this research to consider all of the factors which would contribute to the decisions. This section defines the areas that are considered and describes some others that are beyond the scope of this research.

In order to move from the conceptual discussion that has been presented thus far to a more rigorous study, a structural model of the AFSC consolidation must be formulated. It is, in fact, this structural model and the variables it contains that define the boundaries of the AFSC consolidation study.

Boundaries of the Study

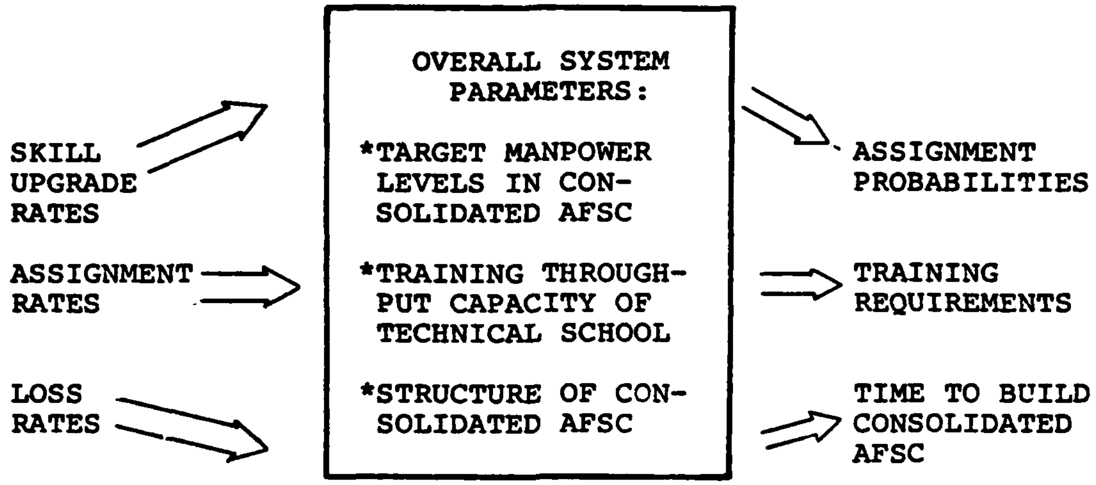
The system to be studied in this research is shown in Figures 2 and 3. These figures define which variables and parameters are to be included in the research.

Figure 2 is a general diagram in which the system variables and parameters are defined. Its meaning is this: if one views the consolidation of AFSCs as a process, then the consolidation's parameters relate the input variables to the output variables.

The input variables are the givens of the present AFSC structure: assignment, upgrade, and loss rates. The AFSC consolidation will operate on these inputs by changing the AFSC structure.

The consolidation process itself is characterized by certain parameters which actually represent policy decisions. These parameters specify the ultimate manpower goals for the consolidated AFSC, the division of manpower into five and seven levels, and the speed at which the training will be conducted.

The output variables are measures of the impact of the consolidation process. The output variables are also



<u>Definition of Variables and Parameters</u>

Input Variables:
- *Assignment Rates--The number of personnel returning from or going overseas in a given month.
- *Upgrade Rates--The number of personnel changing to a higher skill level in a given month.
- *Loss Rates--The number of personnel leaving an AFSC in a given month.

Policy Parameters of the System:
- *Target Manpower Levels--The number of five and seven level personnel that will be attained and maintained in the consolidated AFSC.
- *Training Throughput Capacity--The maximum number of graduates from the technical school into the consolidated AFSC in a given month.
- *Structure of Consolidated AFSC--The ratio of five to seven level personnel in the consolidated AFSC.

Output Variables:
- *Assignment Probabilities--The monthly number of overseas assignments divided by the personnel in CONUS available to fill the assignments.
- *Training Requirement--The number of technical school graduates per month necessary to meet consolidated AFSC manpower targets.
- *Time to Build Consolidated AFSC--The number of months required to build up to a given target level of personnel in the consolidated AFSC.

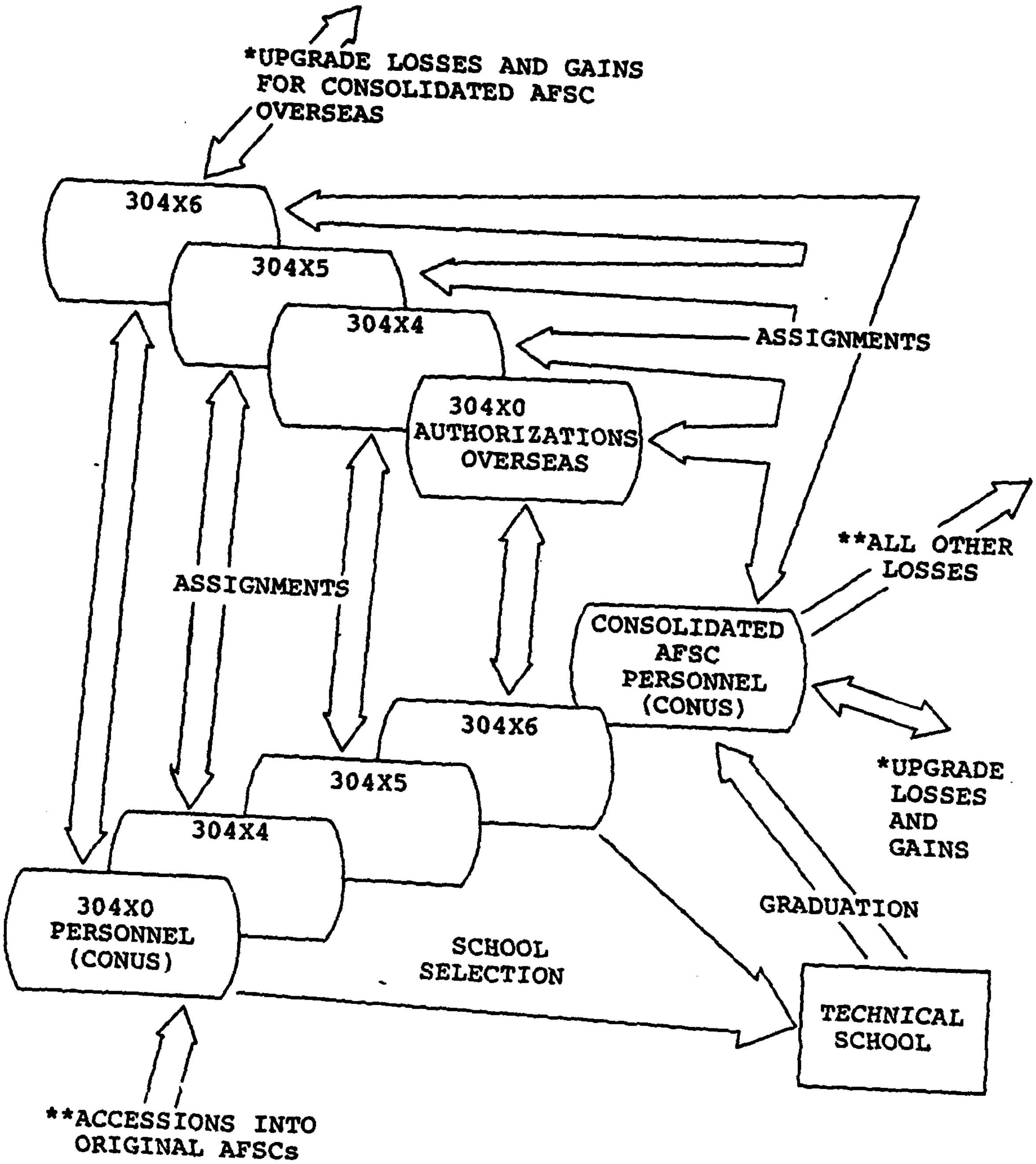
Figure 2

Structural Model of an AFSC Consolidation the answers to the research questions that were posed. The structural model indicates that the input variables and parameters are the essential features of the system needed to predict the output variables' values.

Figure 3 is a more detailed view of the internal structure of the AFSC consolidation process. The arrows in Figure 3 actually represent flows of personnel between the technical school, CONUS, and overseas assignments in the various AFSCs. This structural model embodies the conceptualization of the AFSC consolidation as presented in the background section.

It must be emphasized that the structural model is designed to support the solution of the problem statement. It is not meant to portray a general situation or state of affairs. Variables are included or excluded as they directly relate to solving the problem through answering the research questions. This philosophy is derived from Shannon (28:208), who says, "A model should only be created for a specific purpose, and its adequacy or validity evaluated only in terms of that purpose."

An added stipulation on the problem is to examine these effects in a dynamic fashion rather than with a static or steady state mathematical model--such as the McIntyre Model. This added stipulation is imposed because transitory effects are certainly of interest in a project involving thousands of individuals and potentially millions



*This diagram depicts the model at a single skill level. Upgrade losses at the five level are gains to the seven level. Upgrade gains are zero at the five level.

**Accessions into original AFSCs balance all other losses.

Figure 3

Internal Structure of the Model

of dollars in training and human costs. This stipulation, dynamic analysis, led to a decision to use computer simulation techniques to solve the problem.

Significant Areas Outside the Research

The following areas are important to evaluating the impact of an AFSC consolidation but are outside the scope of this research.

Feasibility of Consolidation. A decision as to whether two career fields are sufficiently similar to merge their personnel is made through analyzing an Occupational Measurement Survey (30:1). This survey essentially compares the task and theory requirements of the two career fields to define their degree of commonality. It could be argued that the survey gets the answer to the wrong question. The survey determines whether two career fields are currently similar. Perhaps it should address whether personnel could master both sets of theory and task requirements. For the purpose of this research, feasibility will not be considered.

Cost-Benefit Analysis. Additional training costs to support the proposed consolidated AFSC are an obvious cost component. Managerial flexibility, by having personnel available to fill assignments in any of four specialties, is certainly a benefit. Improving retention by reducing unfaborable rotation patterns is another possible benefit. This research, however, is designed to measure assignment probabilities and training requirements relevant to a cost-benefit analysis rather than perform that analysis. Therefore, it is beyond this research to identify cost components or quantify benefits.

Job Satisfaction/Performance. It is possible that creating a consolidated career field could have a favorable effect on job satisfaction within the career field. Literature reviews on the subject present a mixed perspective.
The job enlargement aspect could increase satisfaction (11: 250-279; 19:395-403). However, other research indicates that performance determines satisfaction rather than the reverse (15:20-28). Increasing job complexity could decrease performance and thus decrease satisfaction. It is not possible to provide a simple answer to this. The impact of the proposed consolidation on job performance and satisfaction will not be considered in this research.

Training Requirements. The Air Force training methodology is based on two ideas--teach only what is needed, break each job into simple tasks (5:25). This is a philosophy of specialization brought about by a sharp upturn in equipment complexity after World War II (5:23; 23:29). Now that technology and systems theory are shifting the balance, the notion of generalization needs to be reexamined. This is appropos the consolidation because it will essentially produce generalists. There is, in fact, an experiment being conducted to compare the performance of two groups of maintenance technicians (4:1). One group is being trained heavily in electronics theory to produce a more generally qualified individual. The other group is receiving the standard entry level Air Force technical training school. It will be a few years before the results of this experiment are available. Furthermore, it is beyond the scope of this research to define the requirements for a consolidated AFSC training course.

Methodology

The methodology, briefly stated here, will be developed fully in Chapter III. In general, the research questions posed above were answered using a computer model and stochastic computer simulation techniques. That is, the essential features of the system were formed into a structural model. The structural model was computerized and run using values (for the variables and parameters) that were measured from real world data. Measurements made through the model show the dynamic features of the system.

Several runs of the computer model were made following a predetermined experimental design which had two objectives. First, the experimental design organized the factors that were varied. In this case, various target manpower levels, training rates, and ratios of five and seven skill level personnel for the consolidated AFSC were tested.

Second, the experimental design provided for multiple runs of the computer model at each of the various factor levels to reduce the variance in results due to random fluctuations. The exact experimental design that was used is fully developed in Chapter III.

Assumptions

In general, the assumptions made are of three types. First, there are assumptions related to a particular world view. Second, there are assumptions made to infer quantities that do not exist and cannot be measured. Third, there are assumptions made to eliminate irrelevant factors and thus define the system.

World View Assumptions

These assumptions relate to the way the structural model is computerized. To illustrate, one might view each assignment as a discrete event which occurs at a definite point in time. Alternatively, one might view assignments as a continuous flow of personnel between two different "states" (CONUS and overseas). It is also possible to mix these views and this is, in fact, the technique used here. The following assumptions effectively define the world view adopted here.

All assignments to and from overseas are modeled as a continuous flow of personnel. This assumption bypasses the unique features of each individual assignment. Although each individual assignment is made based on criteria to ensure equitability, these criteria are ignored. The view is that regardless of how assignments are made, they occur in certain numbers during definite intervals. The assignment process is modeled as an average number of assignments in an interval of time. The assumption itself is neither valid nor invalid except in relation to how results are interpreted.

Selection for the training school and graduation from the training school into the consolidated AFSC are viewed as discrete events that occur at definite points in time. Schools do start and end at definite times. The view here is that all prospective students leave their current billets within such well defined time periods that the event can be modeled at a discrete point in time. This is relatively true only when the interval is short compared to the length of time the school lasts. A similar argument is applied to school completion.

Unmeasurable Quantities

Assumptions are also made to derive values for unmeasurable quantities. Since there is currently no consolidated AFSC, its characteristics can only be inferred. These inferences are based on three broad assumptions. First, the consolidated AFSC will draw proportionately on the four existing AFSCs.

This first assumption supports a number of inferences that are drawn regarding quantities such as retention rates, overseas assignment eligibility, school selection, and skill upgrade. It is a necessary assumption and the most reasonable one to make in the absence of any specific plans to establish quotas for selection from the original AFSC into the consolidated AFSC.

A second assumption of this nature is made regarding the data base used for this research. The personnel records of some 9,000 airmen in the four AFSCs are the principal data used. It would be impractical to measure the characteristics of these airmen directly. Therefore, the data base is assumed to be accurate. Its source was the personnel records at AFMPC.

The final assumption is that the employment of personnel from the consolidated AFSC would in part be targeted to alleviate the overseas imbalance of the original AFSCs. It is reasonable to assume this since that is one of the stated objectives of the proposal that motivated this research.

Delimiting the System

It is not possible to address the literally infinite number of factors which are ignored as not relevant. The attempt here is to speak to some of the more important factors that are being excluded from the model in order to focus the study more clearly.

Personnel in the four original AFSCs continually upgrade their skill level and move into new categories for assignment consideration. This factor was disregarded. The number of personnel in a given AFSC and skill level was treated as a constant except for losses due to retraining into the consolidated AFSC.

To include upgrades directly into the model would involve judging how successfully the personnel system can control desired manpower levels. According to an expert source (2) the means to directly control the number of seven skill level personnel, for instance, is limited. Basically the mechanism is to control the number of three levels by controlling the number of personnel in the basic technical training course. This, coupled with retention rates and skill upgrade times, controls the number of five levels, which subsequently determines the number of seven levels.

Including the upgrade factor in the original AFSCs would thus expand the scope of the study beyond what is practical. Furthermore, it would obscure the results of the focal study. On the other hand, since skill upgrade within the consolidated AFSC does directly influence the study, skill upgrade is included within the consolidated AFSC.

A similar argument is made to include retention or the discharge process only in the consolidated AFSC. Again, to include it in the four original AFSCs would be to simply add a variable that would then have to be controlled within given limits based on personnel system policy. It makes more sense to treat manpower levels in the original AFSCs as interacting only with the consolidated AFSC. Again, these assumptions are grounded in the belief that this simulation or modeling is directed toward solving a specific problem--not portraying a situation.

CHAPTER II

LITERATURE REVIEW

Overview

This chapter focuses on four major topic areas. First, a general overview of the Air Force personnel assignment system is presented. This is followed by a discussion of the general types of models with notes on potential applications and a brief review of some representative models with an examination of their weaknesses and reasons for not using them in this study. Lastly, the authors review some of the modeling languages available with rationale for rejection or adoption for this research.

The Air Force Personnel Assignment/Rotation[3] System

The Air Force currently stations over one-third of its military personnel outside the continental United States (CONUS) (29:30-31). The system established to manage the assignment and rotation of military personnel to serve in these non-CONUS (overseas) locations must deter-

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[3]Assignment/rotation refers to the periodic relocation of personnel, normally from CONUS to non-CONUS locations or vice-versa. This relocation, in effect rotates different personnel through each overseas authorization or slot at predetermined intervals. The terms assignment or rotation will be used synonymously throughout this report.

mine and implement policies necessary to ensure a balance of several potentially conflicting objectives. These include, but are not limited to, minimizing the costs of rotation, maintaining acceptable levels of effectiveness and readiness at overseas locations, and treating military personnel and their families equitably (10:354). In addition, there is an important impact of assignment policy on retention and the career decisions of military personnel. There is support for the contention that low retention rates in some career fields are related to prolonged or repeated assignments to non-CONUS locations (2; 9:1-5; 29: 1-3).

Because of conflicting goals and the complex interactions of manpower planning, manpower requirements, personnel management costs and retention, assignment policymakers need a method to measure or obtain an understanding of the impacts of policy changes. Because of the dynamic nature of these interactions, any study of setting rotation policies or making policy changes must take a dynamic and systemic orientation. It is the objective of this research to study a particular policy in the context of a dynamic system model.

The Air Force's interest in rotation policies derives from the direct expense of rotating personnel and from the more important effects on force size, force structure, combat effectiveness, retention, productivity, and efficient use of personnel (26:327-330). Initially, the Air Force needs a better understanding of rotation policies, practices, and supporting rationale (10:347). Accordingly, this research provides a structured method to study a specific policy to illuminate rotation-originated constraints on the manpower system early on, in the planning stage, thus allowing the effects of policies to be studied and evaluated prior to costly implementation.

Assignment/Rotation Policies

Overseas tours are divided into two broad categories--accompanied and unaccompanied. Accompanied tours allow military personnel to take their dependents with them while unaccompanied tours do not. Another category is called the "All-Others" tour. It applies to personnel assigned to an accompanied status location if they are bachelors or if they elect to leave their dependents at home (i.e., if they are unaccompanied in an otherwise accompanied tour).

Overseas tours are categorized by considering the state of readiness and evaluating the living conditions of the particular location. To determine if a location is categorized as unaccompanied or accompanied, current policy considers several criteria. Some general criteria considered are proximity to population centers, standards of living conditions, and general desirability of the particular location. A more detailed discussion of categorization criteria and some examples can be found in Smith's work (29:16-17).

Assignment policy also differentiates between first term airmen, those in their first four years of enlistment, and career airmen or those with more than four years of previous service. Policies are often different for these two broad groups of personnel (10:351; 20:16). There are, additionally, subgroups within each of these major groups. Women and understaffed technical specialties are two of the more relevant subgroups that concern policy-makers. For example: women are not assigned to combat skills or to locations/jobs that may potentially expose them to capture by an enemy or hostile fire; nor are they normally assigned singly to isolated locations or remote duties. This has the effect of increasing the probability that men will be assigned to hostile or undesirable locations and subsequently impacts their probability of serving more of those types of tours. While this particular policy would probably not be changed even if impacts were known fully prior to implementation, it is still desirable for planning purposes to know of potential impacts before implementation.

Because there exists a perception that some overseas locations are less desirable than others, the Air Force (as well as the other military services), has imposed time limitations on overseas tours (9:2). This is an attempt to ensure that undesirable tours are not imposed on one or a few individuals and that problems with force loyalties will not develop because of long-term associations with foreign populations (29:1). The theory is that imposing limits will force rotation of the tours among individuals. In practice, however, there is little, if anything, to prevent individual members from voluntarily spending a large portion of their military career at overseas locations. Overseas tours on the average are usually twelve months for unaccompanied tours, thirty-six months for accompanied tours, and twenty-four months for the all-others tours.

The Methodology

The general Air Force methodology concerning assignments and rotations is to maintain a pool of overseas eligible personnel in the CONUS to fill non-CONUS assignments (20:1-3). The most eligible CONUS personnel are rotated to overseas slots (authorizations); personnel returning from overseas are placed in vacant CONUS slots; and the remaining CONUS requirements are filled by whomever is left. Eligibility is determined primarily by a seniority ranking of personnel based upon the number of overseas tours an individual has already had and the date of last return from overseas for each category of tours. Thus, unaccompanied short (twelve month) tours, known as remotes, are considered separately from accompanied (twenty-four to thirty-six month) tours (2; 6:29-35; 16:9).

In the past, equity was the primary focus of the assignment system, but recent emphasis is on stabilized tour lengths, even if equity suffers (2; 29:31). For example, as an incentive to fill overseas tours, airmen are offered higher priority on their next assignment preference if they voluntarily serve a remote tour. Theoretically, an airman could remain overseas nearly indefinitely, as long as his behavior did not embarrass military standards of conduct. The Air Force permits inter-theater and intra-theater transfers when overseas tours are volunarily extended. These are referred to as consecutive overseas tours (COTS).

The Assignment/Rotation Process

The process of selecting individuals for particular assignments is primarily an automated process governed by policies concerning the eligibility and availability of personnel for assignment, lengths of and locations for assignments, family accompaniment, and determination of technical skill requirements needed for available jobs (10: 353-354). While the actual assignment selection is a relatively objective process, it is driven by policy decisions that are primarily subjective and intuitive. There is no intent to imply that policy decisions are intentionally so, but that there are very few analytical tools available to the policy maker to determine the effects of different policies prior to implementation (13:36).

Because of a smaller data base, officer (manager) assignments often receive a more personalized review than do those of airmen (technicians). However, very senior noncommissioned officers and personnel in certain critical specialties do, routinely, receive very detailed attention during the assignment process (9:5). The end result, in practice, is that there are many exceptions to the actual allocation process as explained above and that any attempt to model them in some fashion can, and does, take many different approaches.

There are numerous other assignment policies, dealing with other problems. An exhaustive examination of them is not germane to this research. The intent is to show that policy-making is a dynamic process and any attempt to measure impacts or effects must necessarily be dynamic also.

Modeling

According to Shannon,

> . . . simulation is the process of designing a model of a real system and conducting experiments with . . . (the) . . . model for the purpose either of understanding the behavior of the system or of evaluating various strategies . . . for the operation of the system . . . [28:2]

The term model however, can encompass a broad and diverse range of instruments. They can be simple mathematical formulas or extremely detailed and complex digital computer programs (14:99-166). More important than the complexity, either intrinsic or induced, of a particular model, is its treatment of time and the purpose to which the model results are ultimately applied or used.

Purpose

Models are used primarily for two main purposes. They can be descriptive, to aid in analysis of something; or they can be prescriptive, to aid in prediction or diagnosis of outcomes of, as yet, unobserved phenomenon (28:2). A model which is effective as the latter is often also very descriptive of the particular process or phenomenon; while one that is the former may not necessarily be effective as a predictor of anything. This study will focus on the predictive aspect of a model.

Time

Another equally important aspect of a modeling effort is its treatment of the time dimension. Time can be treated as either static or dynamic. The static treatment either ignores or treats as irrelevant, to the outcome of the modeling process, the passage of time. Models of this type are thought of as "taking a picture" in time of the process being modeled--a sort of "one-shot" method. While simple to implement and effective in many instances, this method can be misleading if used to model a dynamic, changing, or fluid ongoing process of such management areas as personnel assignment or rotation processes.

The dynamic treatment of time allows the model to more closely simulate the real world ebb and flow of interacting and changing variables. This dynamic process can be simulated by allowing either fixed length increments or variable length increments or a combination of the two to occur in a model. The authors believe the ability to examine effects of policy changes over the continuum of time, in graphical and mathematical terms, is clearly superior to merely taking "snap-shots" of the model outcomes.

A Rand research study classified military personnel models in the Department of Defense (DoD) (13:11-32). The broad classifications addressed the dichotomies present in personnel system modeling efforts. There are optimization and non-optimization models, entity or aggregate models, deterministic or stochastic models, and static versus dynamic models. Some of these categories are sub-divided further still (13:11-32). The study (13:20) concludes that:

> No model fully satisfies every planning need, but models are instruments to an ongoing heuristic process that allows planners to test and evaluate the effects of their decisions in the selected ways that mappings of the real world permit.

A brief review of the classifications of models by the Rand study is now presented.

Optimization/Non-optimization

The thrust of modeling in DoD is in the area of finding "optimum" policy decisions given a set of constraints (9:2-3; 13:11, 20-32). Optimization models in the DoD use the optimization methodologies of goal programing, force sub-optimization, and force efficiency (13:22). For a detailed discussion of these methodologies, the reader is referred to An Analytical Review of Personnel Models in the Department of Defense (13). The result of these methodologies is to produce an output of the one "best" policy based on the given constraints. Many of the Navy's and Army's modeling efforts are with these types of models (13:37-52).

Non-optimization models, however, specifically do not attempt to provide a "one best way". They, instead, are a more heuristic approach, used iteratively by the planner within the context of the planner's judgment, to arrive at a range of possible outcomes. This can be a substitute or surrogate for experience (13:11). The output of non-optimization models are viewed primarily as presenting results of relative magnitude versus a "better" choice.

This research can be viewed as a non-optimizing approach in that it permits selection of a range of possible outcomes to be used in conjunction with a particular user's own judgment.

Entity or Aggregate Models

A clear distinction can be made here in the way a particular model treats individuals in the real-world system being modeled. Entity models treat each individual and associated attributes as a separate and distinct member of the data base throughout the simulation. Theoretically, any particular individual's record can be traced or viewed at any point in the simulation (13:13-14).

Entity models usually require extensive data bases and accompanying administrative overhead to manage, with computer run times and memory requirements that are comparatively high (13:13; 28:112-114). The Career Area Rotation Model (CAROM) is an example of this type of model. CAROM will be more completely discussed in a later section of this chapter (16; 33).

Aggregation of individuals into packets or groups possessing like or similar characteristics is one method that can be used to overcome some of the limitations of entity models. However, the characteristics used to aggregate the groups are obviously critical to the eventual interpretation of the output produced by the model. The trade-off appears to be a reduction of computer run time and data manipulation overhead for a possible loss of detail or potential loss of validity depending upon the aggregation schemes selected (13:13-14).

The approach used in this research is to avoid these limitations by approaching the problem from a different perspective. Personnel system transactions are viewed as "flows" of personnel between various levels or pools controlled by policy rates. Although this level of abstraction completely ignores individuals, it considerably reduces computer execution times and data administrative overhead while still providing sufficient information on the effects of policy changes on the entire AFSC as a group.

Deterministic Versus Stochastic Models

The distinction in this categorization is based on how the interval between states or rates of flows are computed within the model. If the amount of change is known empirically and applied in that fashion, the model is considered to be deterministic. However, if some form of statistically derived distribution is applied, the model is categorized as stochastic. "The use of random numbers then, accounts for variability in real-world events that is beyond the purview of the model's definition or structure [13:16]."

The approach of this research is to examine the empirical data available and derive statistically significant distributions of all relevant variables in the model. These are then applied by the mechanism of random number streams to induce the necessary variability and requisite variety as might be expected to occur in the real-world.

Models

Career Area Rotation Model (CAROM)

CAROM is an existing Air Force personnel model developed for the Air Force Human Resources Laboratory (AFHRL) (11; 16). CAROM was used in at least two previous thesis efforts at the Air Force Institute of Technology (AFIT) by Needham and Faucheux (6; 18).

CAROM was examined to see if an existing model could be used to study the problem being considered in this research. CAROM is a FORTRAN-based, non-optimization, entity simulation, stochastic, static model. Therefore, individuals are treated as separate entities, random variability is induced, and the output is a picture in time of the state of the modeled AFSC.

The CAROM model progresses all personnel in a single AFSC through the typical facets of their career accession, promotion, skill upgrade, assignment, and discharge/retirement (16:22). CAROM was developed as an analysis tool for the Air Force to simulate the results of changes to existing personnel policies (16:6).

The limitations of the CAROM model for this study are that it is oriented to modeling a single AFSC and that its output information is rather general in nature. This is consistent with its purpose of serving a wide variety of users (16:7).

A review of the CAROM User's Manual (33:56-59) suggested that CAROM might be modified to fit the problem being studied in this research. Lieutenant Larry Looper of the AFHRL provided a program listing and tape of CAROM so that this possibility could be explored.

The conclusions reached in reviewing the CAROM computer program were these. First, CAROM is a highly machine dependent program which uses considerable character and bit manipulation to increase its storage and execution efficiency. Modifying the program would, therefore, be a sizable programing effort in its own right.

Second, CAROM requires extremely detailed and voluminous input data to form the individual personnel records that drive the logic of the model. These data can be fabricated from distributions, but the effect on the model is uncertain. For example, if two different parameters were to be created in each record based on distributions, each distribution might be separately correct. However, there might be many cases when the parameters contradicted each other when juxtaposed in a single person's record.

The overall conclusion is that CAROM is probably a very useful model if it can be used as is and if the researcher has direct access to the personnel data base and the time and facilities to build the necessary data records. For these reasons CAROM was abandoned as a research vehicle.

McIntyre Model[4]

The McIntyre Model is the current official rotation base model used by AFMPC. It has apparently been used extensively and routinely as a managment decision tool for Air Force rotation policy for a number of years. The term rotation base, refers to the CONUS assignment pool discussed earlier in this chapter in the section entitled, "Air Force Assignment/Rotation Methodology".

The McIntyre Model is an optimizing, aggregate, deterministic, static model. There is no attempt to simulate impacts on individuals nor to examine any effects of policy decisions on anything except force strengths. In addition, variability is ignored except that which is included by empirical data.

The model is a three stage analysis of aggregate data from the AFMPC data base. Primarily, the model is a series of simplistic mathematical equations that compute three key composite measures for every AFSC. The three measures are based on three officially sanctioned, but not mandated, goals of Air Force assignment/rotation policy. Generally, the goals are: 1) a maximum time any individual could spend overseas in a career; 2) a maximum number of overseas remote tours any individual could serve in a

[4]Also known as the DPMDW Rotation Model. The consensus of users is that someone named McIntyre first suggested or used the model. DPMDW is the office symbol of the office of primary responsibility (OPR) at MPC.

career; and 3) a minimum time an individual should be guaranteed to serve in the CONUS before being reassigned overseas (1:1). A detailed explanation of how the measures are calculated is contained in Appendix D.

Approximately every thirty days (2) each AFSC in the AFMPC data base is examined and total quantities of authorized and assigned strengths are computed and displayed for both overseas and the CONUS. Similarly, using the total overseas authorizations (requirements), the quantities necessary to achieve each key measure goal are calculated by the model and displayed along side the strength and authorization totals. At this point the model output is analyzed by management and calculation of the Unfavorable Rotation Index (URI) is done manually by dividing the CONUS requirements by overseas requirements. This ratio is said to be unfavorable if it is less than one and one half to one. The three key measures, thus, merely indicate the "ideal" CONUS rotation base given the computed overseas requirements. In that sense, the model output merely serves as a "flag" to policy-makers that a problem may exist.

The model is limited to evaluation of changes to the three key element measures or to changes to gross overseas requirements. Additionally, the model presents only one (of each of the three measures) data point out of the potentially thousands, or at least hundreds possible. Basing any policy decisions on this type of data is extremely tenuous. By their own admission, policy-makers find McIntyre extremely limited (1:3; 2).

Modeling Languages

The final computerization of the structural model was attempted only after a review of several different simulation languages was completed. This review was done to find a language that could embody the structural model and the world views that evolved in this research. A brief summary and comparison of these languages follows. The essence of the review was to consider how well these languages could model the problem at hand.

Q-GERT

These comments regarding Q-GERT are based on Pritsker's book, Modeling and Analysis Using Q-GERT Networks (21).

The objective is to describe the principle features and limitations of Q-GERT. Q-GERT is essentially a network modeling language where entities move through activities over simulated time. The start and stop of activities occur at definite times defined by entity arrival at a node (21:3-4).

The language generates considerable variety from this simple basis by allowing entities to carry attributes or characteristics along with them. These attributes can be the basis for a variety of decisions made at the nodes (21:133). For instance, an attribute or characteristic can be used to determine the path of the transaction through the network, or the time it takes to complete an activity.

The application to personnel modeling is direct and forceful. Individuals can be modeled as entitites passing through assignments of a given duration or waiting at nodes to receive an assignment. Attributes can be used to describe an individual's time in service or overseas return date, for instance, as a basis of future assignments.

The review and study of Q-GERT culminated in a prototype personnel rotation model to study the feasibility of producing the thesis model in Q-GERT. This idea was ultimately rejected for two reasons.

First, Q-GERT limits the user to a maximum of four hundred entities in the model at any one time. Since thousands of personnel are to be modeled, some form of aggregating individuals into clusters or groups had to be developed. The authors believe this is undesirable and could be avoided.

Secondly, Q-GERT appears to be oriented toward the process or mechanism of personnel assignment selection instead of policy implementation and evaluation. This tendency made it unlikely that the flow of groups or packets of individuals discussed above could be satisfactorily modeled.

Dynamo

According to Richardson and Pugh (24:x), "The computer simulation language DYNAMO has been associated with systems dynamics from the beginning." Therefore, it is worth noting their description of the types of problems that normally can be addressed by systems dynamics.

Richardson and Pugh state that systems dynamics problems have two features in common: a dynamic or changing nature of the variables and feedback forces. Feedback is defined as ". . . the transmission and return of information . . . [24:3; 27:65-74]". Presumably that information has a subsequent effect on the variables.

When viewed from its characteristics a DYNAMO model is fundamentally a system for modeling continuous variables. Discontinuous changes can be incorporated through selected DYNAMO mechanisms. Nevertheless, the basic world perspective is that systems are viewed most effectively in terms of their common underlying flows instead of in terms of separate functions (24:4; 8:3; 9:2-4).

As described by Buffa and Dyer (3:87), the DYNAMO simulation language is composed of three fundamental types of equations. First, level equations represent accumulations of flow rates which can raise or lower a level. The value of a level at a given time is equal to the value at a previous time plus the net flow during the elapsed interval. Second, rate equations control the size of the flows. Typically, rate equations, and consequently flows, are based on a current or past value of some level or auxiliary variable. For example, the flow of water from a lake would depend on the current level of water in the lake.

Thirdly, auxiliary equations, as defined by Roberts (25:26), represent informational concepts that are inputs to other auxiliaries or to rate equations. As an example, an auxiliary might represent the average value of a level over a period of time. The average is not an actual entity, but is an abstraction or piece of information relevant to the modeled variable.

Using these basic equation types and several technical artifacts which extend its flexibility, DYNAMO is capable of tracking the many complex interactions existing within a given system. DYNAMO offers an entirely different perspective from that of Q-GERT. In DYNAMO the structure of the model becomes the key behavior determinant.

In the context of the problem being studied in this research, DYNAMO offered the ability to focus on the dynamics of the personnel flows without becoming embroiled in considering the myriad details involved in individual personnel actions. At the same time, computerizing the system model of the problem in DYNAMO presented some obstacles.

Because modeling the technical training school as a discrete type event was desirable and probability distributions are required in modeling some of the model variables, the attractiveness of DYNAMO declined. In addition, certain events take place contingent upon the value of variables in the model (e.g., closing the training school temporarily when sufficient personnel have been trained).

Although these situations discussed above can be modeled and Richardson and Pugh (24:103-131) demonstrate the methods to be used, DYNAMO is not as flexible as was desired. Circuitous methods would have had to be used to accomplish what would be straightforward in another language. This limitation led to a search for a language similar to DYNAMO but with additional flexibility.

SLAM

SLAM is an acronym that means Simulation Language for Alternative Modeling. It is the simulation language employed for this research. SLAM essentially encompasses all the desired features of the previously discussed languages. SLAM is capable of any combination of network, continuous, or discrete methodologies in a single model

(22:vii).

SLAM has the capability of Q-GERT (network) and DYNAMO (continuous) and also permits discrete events to be modeled. Since network and continuous simulation languages were reviewed in some detail in discussing Q-GERT and DYNAMO, these aspects of SLAM will not be considered in detail here.

SLAM, like Q-GERT and DYNAMO, is a FORTRAN-based language. This allows the modeler to write extensive subroutines in FORTRAN to model discrete events (22:230-231). The implementation of these subroutines in SLAM is much more flexible than in the other languages. This feature is of considerable value in this problem in modeling the operation of the training school for the consolidated AFSC.

Because the three simulation modes can interact in SLAM, it becomes possible to base the occurrence of discrete events on values of continuous variables or network events (22:402-403). In the problem studied here, this permitted the discrete events modeling the technical school to mesh with the continuous flow of the assignment system. Further, it allows the discrete and continuous systems to be imbedded in or controlled by a network.

The network portion detects when the technical school should be closed or open. It controls the overall length of the simulation and the simulated time when the consolidated AFSC is to be created. Finally, the network models the use of the technical school's available capacity to handle a number of classes.

Two additional advantages of SLAM are the wide range of probability distribution functions provided, and the flexibility offered in tailoring the graphical output of the results (22:232-234). All of these features taken together led to a decision to computerize the structural model in SLAM.

CHAPTER III

METHODOLOGY

Research Questions

Overview

This section will develop the research questions into a set of testable statistical hypotheses or measurable variables, as appropriate.

Research Question One

How would various manpower levels in the consolidated AFSC affect the assignment probabilities in the four original career fields and the consolidated AFSC?

This question was answered in a steady state or equilibrium condition. Equilibrium has been defined as attained when the consolidated AFSC has intially built up to its target manpower level, as simulated in the computer model.

It would not be useful to form hypotheses on the assignment flow rates themselves. While flow rates might decrease after the consolidation, this would be due to a smaller number of personnel in each AFSC. Using the assignment probability corrects for this effect and still provides an easily interpretable results. For example, an assignment probability of three percent implies that three out of every one hundred personnel in CONUS will receive an overseas assignment.

The assignment probabilities can be expressed mathematically as follows: let,

ASAOS(A,S) = average number of personnel per month going to an accompanied (or long tour) assignment in AFSC A at skill level S.

ASROS(A,S) = average number of personnel per month going to a remote assignment in AFSC A at skill level S.

ASMOS(A,S) = average number of personnel per month from the consolidated AFSC going to an accompanied assignment in AFSC at skill level S.

ASMROS(A,S) = average number of personnel per month from the consolidated AFSC going to a remote assignment in AFSC A at skill level S.

ACON(A,S) = the number of personnel in AFSC A at skill level S who are in CONUS.

MCON(S) = the number of personnel in the consolidated AFSC at skill level S who are in CONUS.

Then the following average probabilities are defined:

$$APROB(A,S) = \frac{ASOAS(A,S)}{ACON(A,S)}$$

= the average probability that a person in AFSC A at skill level S receives an assignment (accompanied) overseas.

$$\text{ARPROB}(A,S) = \frac{\text{ASROS}(A,S)}{\text{ACON}(A,S)}$$

= the average probability that a person in AFSC A at skill level S receives an assignment (remote) overseas.

$$\text{MPROB}(S) = \frac{\text{ASMOS}(A,S)}{\text{MCON}(S)}$$

= the average probability that a person in the consolidated AFSC receives an assignment (accompanied) overseas.

$$\text{MRPROB}(S) = \frac{\text{ASMROS}(A,S)}{\text{MCON}(S)}$$

= the average probability that a person in the consolidated AFSC receives an assignment (remote) overseas.

From the probability definitions given above, the following statistical hypotheses were formed:

$$\text{Ho:APROB}_{b}(A,S) = \text{APROB}_{at}(A,S) \quad (1)$$

$$\text{Ho:ARPROB}_{b}(A,S) = \text{ARPROB}_{at}(A,S) \quad (2)$$

The subscript "b" refers to a baseline value of assignment probability. As a basis for comparison, the computer model was run without establishing a consolidated AFSC. The results of five computer model runs were averaged for each AFSC and skill level to establish the baseline values.

The subscript "a" refers to probability values measured after equilibrium was attained. These probability values were measured with a consolidated AFSC established.

The subscript "t" means that various treatments were used. These treatments correspond to different parameters of the consolidated AFSC. For example, assignment probability was measured for different values of total manpower in the consolidated AFSC. Each value of total manpower corresponds to a different treatment. As in the case of baseline measurements, five runs of the computer model were made to establish the average assignment probability values with treatment.

In order to actually perform the hypothesis tests, the statistical distribution of the average assignment probabilities had to be determined. An important consideration, then, was to use a long enough measurement period (simulation time) so that the average assignment probabilities would be normally distributed. This is the result that would be expected according to the Central Limit Theorem under the condition that the distribution of the individual monthly measurements be reasonably well-behaved (10:183).

With the above in mind, the average assignment probabilities were tested with a Kolmogorov-Smirnov (K-S) test to determine if their statistical distributions were indeed normal. With confirmation from the K-S tests, the hypotheses were tested at the five percent significance level using t-tests. That is, for each AFSC and skill level, a test was made to see if consolidation significantly changed the average assignment probabilities. This was repeated for each possible set of parameters of the consolidated AFSC studied in this research.

The parameters of the AFSC consolidation were structured in a purposeful manner to get full value from the research. Three separate parameters were varied--total manpower in the consolidated AFSC, proportion of five to seven level personnel, and training throughput rate. Each run of the computer model used one particular value for each of these parameters. The parameters were structured as shown in Figure 4.

Referring back to the hypotheses in equations one and two, a treatment corresponds to running the computer model with each of the parameters set to a particular level. Consequently, t-tests were performed for each possible combination of levels. Four manpower levels, three proportions, and three rates imply thirty six possible cominations or treatments. Certain infeasible combinations reduce this number to 27. A more complete discussion of the combinations occurs in the section on experimental design.

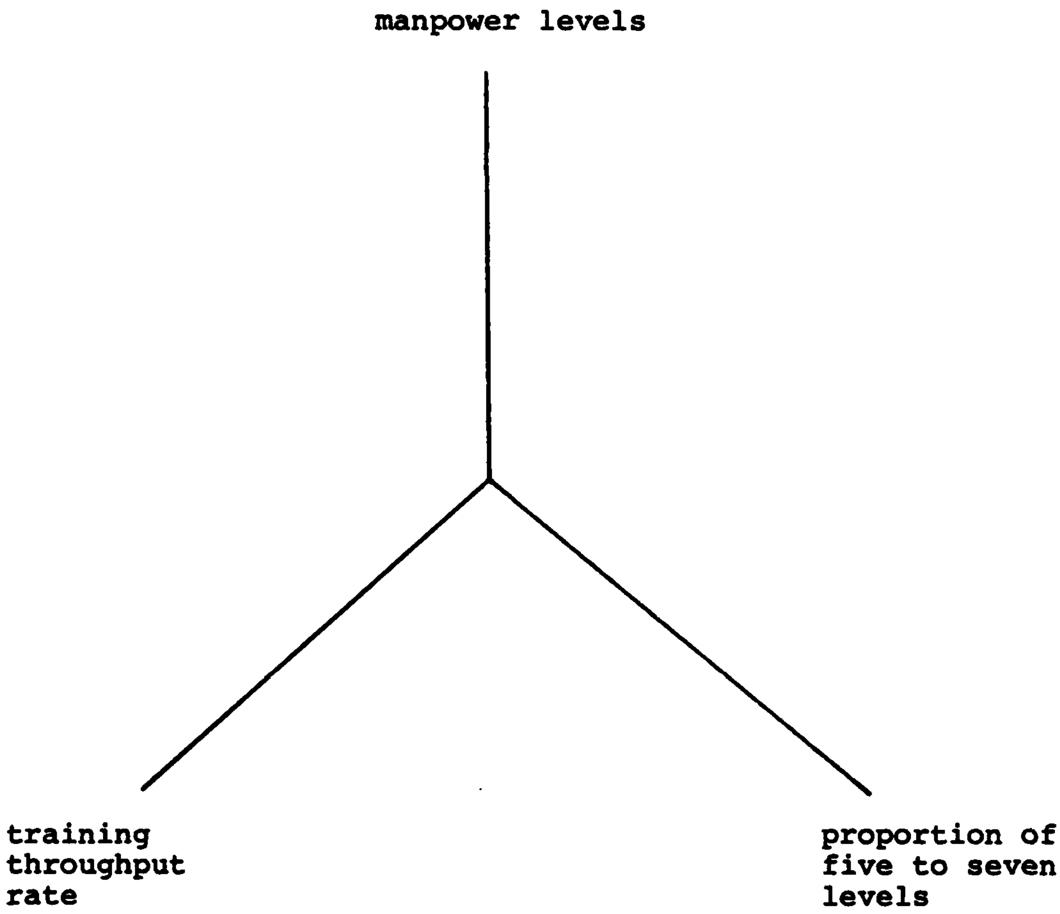


Figure 4

Parameters of the AFSC Consolidation

The structure shown in Figure 4 suggested an additional type of analysis--Analysis of Variance (ANOVA). In this research, the main objective of the ANOVA was to test for interactions between combinations of parameters. For example, training throughput and manpower level may interact to produce an effect not explainable in terms of either individual factor.

Testing for such interactions was accomplished with an ANOVA. Each combination of parameter values corresponded to a cell in the ANOVA. Each cell contained the five measurements of average assignment probabilities obtained from the model runs. The K-S tests performed previously confirmed that the average assignment probabilities were normally distributed--a prerequisite for the ANOVA.

The statistical tests used can be summarized as follows. First, K-S tests were used to verify that the underlying distributions could be treated as normal distributions. Second, t-tests were used to compare baseline probability measurements (no consolidated AFSC) to probability measurements with a consolidated AFSC structured in a particular manner. Third, an ANOVA was used to look for possible interactions between parameters of the consolidated AFSC.

Research Question Two

What is the training throughput rate necessary to sustain a given consolidated AFSC manpower level?

The two components of this question are to measure the overall training requirement which replaces losses, and the division of the training requirement between five and seven level personnel. This was measured in the computer model by the average number of personnel in the training school during the equilibrium period of the simulation.

The computer model tracks the number of five and seven level personnel in the training school as separate quantities. Therefore, the mixture of five and seven skill level personnel was directly determined from the model.

Since over the long haul the training throughput must balance losses due to discharge, cross-training, retirement, and other factors, this measurement was highly sensitive to those factors. The measurement obtained by the model can, therefore, only be approximate, since losses are controlled by a wide variety of environmental variables.

In fact, if URIs are favorably impacted by the implementation of a consolidated AFSC, the loss rate may vary from the value used in the model. However, it was not possible in this research to incorporate that possible feedback effect into the model.

Research Question Three

How would various training throughput rates and manpower levels affect assignment probabilities in the original AFSCs during the transitory period?

The intent of the question is to fill the gap between the baseline measurements and the equilibrium measurements of assignment probabilities. During the transitory period, the technical school was operated at its maximum capacity. Model runs were made for the three throughput rates considered in this research. The objective was to estimate the effect of various pipeline sizes on the assignment probabilities.

The technique used to answer this question was to make graphical displays. These graphs illustrate the qualitative features of the transitory period. The objective is to show the tradeoffs available between the magnitude and duration of effects.

Two sets of displays were developed to portray the transitory period. The first set illustrates the number of five and seven level personnel of the consolidated AFSC in CONUS, overseas, and in the technical school over time.

The second set graphs assignment probabilities over time. Assignment probabilities were graphed for three throughput rates and four different manpower levels of the consolidated AFSC. This method permitted comparison of the effect of changing various consolidation parameters. It would not be practical to exhaustively display every combination of factors considered in this research.

A second purpose of research question number three was to define the length of time it takes to reach a given manpower level. Essentially this was a measurement of the duration of the transitory period. To a first approximation, the transitory period's duration should equal the target manpower level divided by the training rate expressed in personnel per month. However, there were losses occurring while manpower in the consolidated AFSC was building to the target level. These losses were, in general, proportional to the manpower level. That is, there were more discharges and upgrades, for instance, in a large AFSC than a small one.

As a consequence of the proportional losses that occur while building to the targeted manpower level, the transitory period should not be related in a simple linear fashion to the target force level. Thus, this research question examined the actual relation of the transitory period's duration to the targeted force level.

Data Sources

The data needed to support this research was obtained from the official personnel records of the Air Force Military Personnel Center (AFMPC), Randolph AFB, TX. This data will normally be referred to as the AFMPC data base in this research. Nearly ten thousand line entries, each representing elements of individuals' records, were obtained.

This data was received in hard copy and subsequently magnetic tape form. The Statistical Package for the Social Sciences (SPSS) was the main statistical tool used to analyze the data. SPSS was used to perform all of the statistical operations described.

It was not practical to validate the data through external sources in any meaningful way. To do so would require contacting individuals to verify data entries. However, AFMPC personnel records represent the sine qua non of Air Force personnel management information. Consequently, the data was accepted as being generally valid.

It was possible to examine the data for internal inconsistencies, however. This was accomplished as the data was processed into useful information. As an example, start and finish dates of assignments were edited to ensure the finish date was after the start date. These edits are explained fully in Appendix A which details the data reduction.

Data Reduction Methods

The data reduction had three principal objectives: determining the model variables, identifying probability distributions and verifying/validating the model outputs.

Determining Model Variables

The model's variables are categorized as levels, rates, and auxiliaries. The actual classification of the variables into these categories is shown in the program listing in Appendix C. The methods used to process the data in each of these categories will now be discussed.

Levels within the model, such as the number of personnel in a particular assignment status, are first determined by their initial values and then by accumulating the net flows into the level. The initial values of the levels are determined from manpower authorization records. Consequently, these initial values required no statistical analysis. Measuring the flow rates is discussed below.

The auxiliaries in this model are essentially aggregations of flows and levels. That is, a personnel level summed across all AFSCs at a given skill level is treated as an auxiliary variable. As such, the auxiliaries are not directly measured from the data collected. They are derived from other variables.

Flow rates, on the other hand, are directly determined from the data obtained from AFMPC. There are three basic flow rates to be described: assignment rates, skill upgrade rates, and discharge rates. Referring back to the structural model of Chapter I (p. 15), these flow rates are essentially the input variables to the consolidation process.

Assignment rates were measured in terms of the number of personnel moving from/to CONUS in a given month. The AFMPC data base had four separate measures of this rate, two projecting forward on future assignments, two looking back on past assignments.

One backward-looking method can be called the Overseas Return Date (OSRD). OSRD is the date on which an individual last returned from overseas. This measure is not categorized by type of assignment (remote or accompanied) but only by AFSC and skill level. These returns were counted for each month back in time. A simple program is shown in Appendix A which accomplished this counting.

The second backward-looking measure is called Date Arrived Station (DAS). The number of personnel that arrived overseas in any given month were counted in a manner similar to OSRD. DAS, however, is categorized in the data by type of assignment. This made it possible to measure separate remote and accompanied assignment rates from DAS. DAS was counted by the same program which counted OSRD.

The first forward-looking measure of assignment rates is called Date of Expected Return from Overseas (DEROS). DEROS represents the date when each individual currently serving overseas is expected to come back to CONUS. DEROS is categorized by type of assignment so it provided separate measures of accompanied and remote assignment rates. Again, DEROS was counted by the program used to count OSRD and DAS.

Before discussing the final measurement, some comments are needed on the past three measures. First, each measurement of assignment rate is determined separately for each AFSC and skill level. Secondly, three measures are needed to provide a cross check. Assignment rates vary from month to month and even from year to year. Therefore, independent measurements help gauge this long term variance in assignment rates.

The second forward-looking measure of assignment rate was an indirect one derived from tour length--the length of time an individual spends on an overseas tour. Simply stated, the number of persons serving overseas in a given tour category divided by the average tour length yields an average measure of the return rate from overseas.

A numerical example of this concept illustrates it best. If there were one hundred individuals in a particular assignment category and they spent an average of twenty months there, then on average five individuals would return each month.

This simple but powerful concept was the measure actually employed in the computer model used in this research. The reason that it is preferred to the other more direct measures (DEROS, DAS, and OSRD) must, therefore, be explained.

DEROS, DAS, and OSRD contain strong cyclical components. This reflects the general preference of individuals to move in summer and early fall as opposed to winter. Without introducing the question of motives, this tendency is simply illustrated in Figure 5.

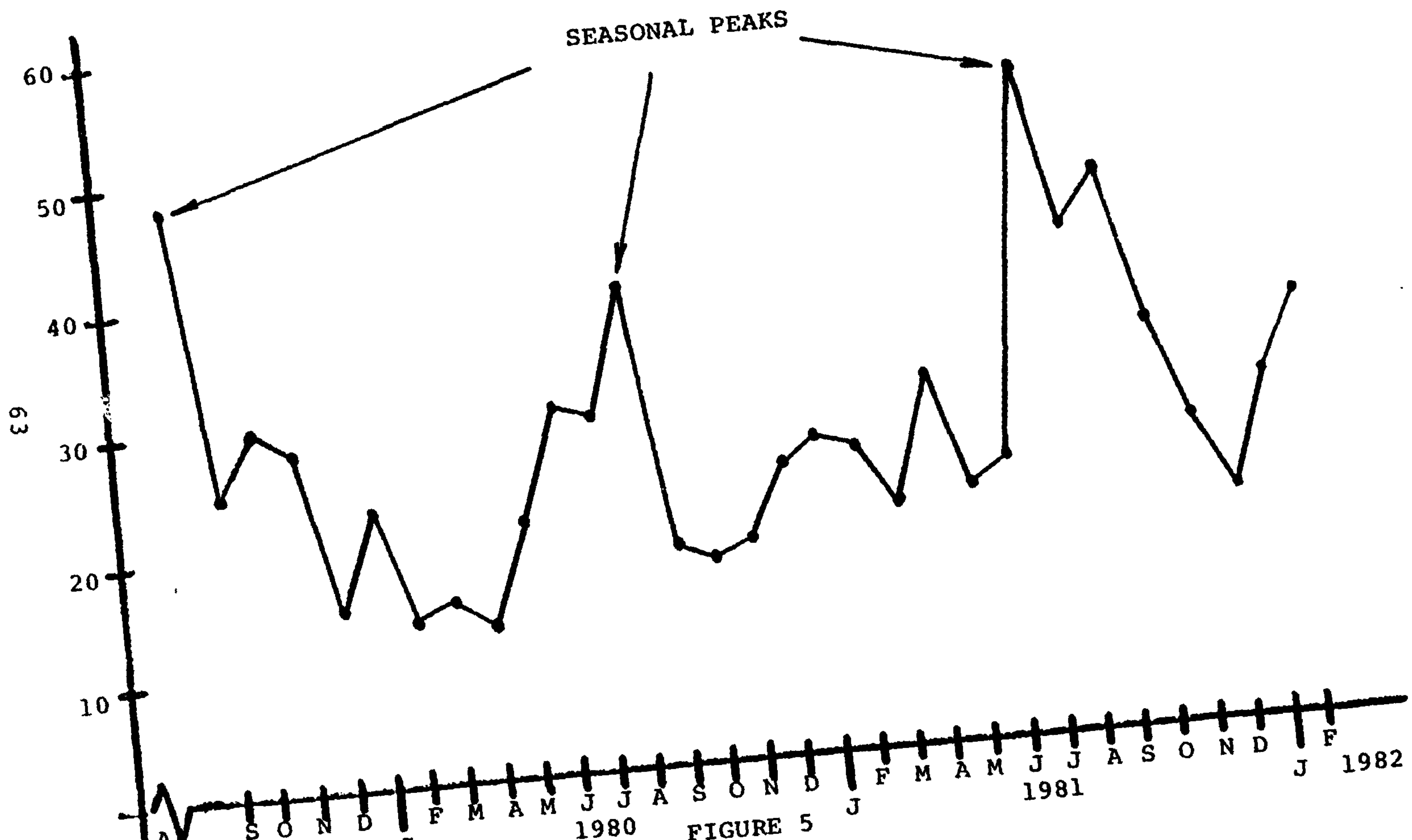


FIGURE 5

TOTAL SEVEN LEVELS RETURNING FROM OVERSEAS

Further, since this research is designed to examine average assignment probabilities, the loss of the annual cyclical characteristic of assignments is of less consequence than if the research attempted to examine individual monthly patterns of assignments.

Finally, while DEROS, DAS, and OSRD are not actively used by the model, they do constitute hard data. As such, they were essential to model validation as described later.

Skill upgrade rates were measured in terms of the average number of personnel upgrading from one skill level to the next in a given month. The AFMPC data actually lists the date a skill upgrade occurred. The number of upgrades in a given month were plotted backward in time for each AFSC and skill level. By averaging the data, a monthly upgrade rate was obtained for each AFSC and skill level.

The loss rates used in the model were obtained from an analysis of the skill level upgrade rates. For example, if personnel managers wish to keep the number of seven level personnel constant, they must balance losses by upgrading personnel to the seven skill level.

Losses at the seven level can be due to cross-training, retirement, discharge, death, or upgrade to the nine level. But whatever the cause, the losses can only be balanced by sufficient upgrades to the seven level.

Therefore, rather than attempt to measure all the separate loss categories, they were simply lumped together and equated to the upgrades.

A similar analysis was fashioned for modeling the loss rate of five level personnel. The analysis states again that the five level upgrades must balance five level losses. The losses can be divided into two components. One component is upgrades to the seven level, the other is all other causes. The seven level upgrades were measurable from the data base. Therefore, the average monthly five level upgrades minus the average monthly seven level upgrades equal the average five level losses from the system.

Identifying Probability Distributions

The purpose of this procedure was to introduce realistic variety into the model. Many of the rates measured (discharge, skill upgrade, and return from overseas) really reflect aggregates of indiviudals' decisions. The data is essentially historical. Rather than represent it as a single value, it was preferable to model it with a probability distribution. This allows for possibly different future rates and frees the model from mirroring the past.

In discussing this concept, Shannon states (28:68)

> As a general rule, we believe a more useful model will result if we can use theoretical distributions.

> Thus we would suggest that empirical data be tested . . . to determine if it fits a known statistical distribution to a statistically accepted level of confidence. If it does, then the theoretical distribution should be used.

Appendix A discusses the derivation of the probability distributions used in this model in conjunction with the measurement of model variables.

<u>Verifying/Validating Model Results</u>

A final purpose of the data reduction was to enable validating and verifying the model. In this case, a model is being constructed of a situation which does not yet exist. Consequently, verifying and validating the model became a two step process.

In the first stage, the model was run without a flow of personnel into the consolidated AFSC. The assignment rates and manpower levels obtained as model outputs were compared to the actual values collected from the data.

In the second stage, flows into and out of the technical school were turned on, producing the consolidated AFSC. In this stage, verification was again determined by examining the changes of the system variables over time. Further, the manpower levels in each AFSC, skill level and assignment category as measured by the model were compared to the authorized levels to insure that the model accurately tracks personnel.

Validation was more difficult because there was no data directly comparable to the model output. Two other methods were available. First, flow rates were aggregated over the consolidated AFSC and the four original AFSCs. Thus, while the apportionment of overseas assignments changed, aggregates of flows were similar to the original data.

Second, face validity was established. According to Shannon (28:215) this involves a piecemeal examination of the model's parts in relation to the results they produce. The objective is to compare these results to the best available projections of how the model should behave.

Face validity was enhanced by the evaluation of the model by experts. In this case, the model was reviewed by functional area specialists at AFCC. Their opinion was especially valuable in examining the structural model and the underlying assumptions.

Sample Generalizability

While the data is verifiable (internally consistent) and can be assumed valid because of its source, there are some points to be made regarding its generalizability. The major portion of the data represents a snapshot of the career field at a point in time. That is, all the records were retrieved at a particular time.

But in another sense, the data represents a composite history of the career fields as contained in the records of the people in the career fields. In principle, that history reflects past periods of manning shortages, changes in authorizations, and discharge losses.

The dilemma then was in deciding how far back to include data when measuring the variables. Going farther back in time could average out recent perturbations. But going too far back means that records of personnel who had left the service during that past period would not be in the data base.

Analyzing only the most current period ties the results too heavily to specific current conditions. On the other hand, little can have happened to destroy the accuracy of the resultant measurements.

The dilemma was dealt with judgmentally. For instance, forward-looking data on assignment rates was not used for the months beyond the minimum tour length. As an example, looking out twenty four months at assignment return rates for remotes would be inappropriate. This is because it would be far beyond the average twelve month tour length for remote assignments. It would, consequently, omit individuals who had not yet gone overseas but who might return in the later months of the analysis.

Backward-looking data was not viewed farther back than twelve months. This limit was set to avoid including measurements which would be strongly influenced by losses which had occurred. Therefore, the data for this research was taken from a twenty-four month window centered on the present time.

As a final comment, a twelve month cluster of data points is necessary because of the cyclical nature of assignments described earlier. To use eighteen months, for instance, would be to include an extra peak or trough. Figure 6 shows the time periods over which data was measured. Tour length is not included on the diagram because it does not apply to any particular time period.

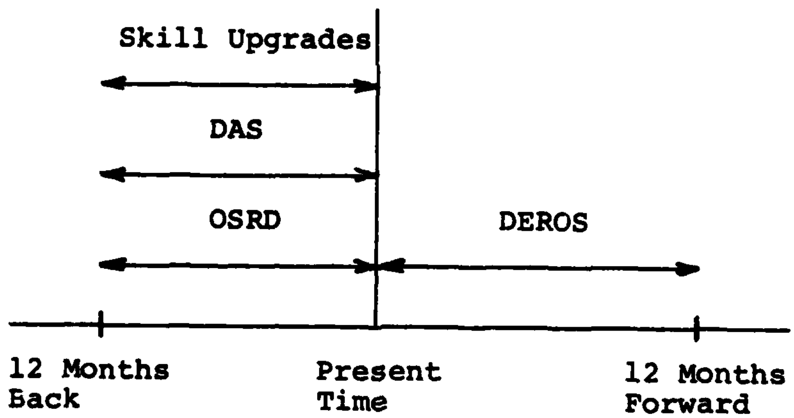


Figure 6

Time Periods Used for Data Measurement

Experimental Design

Objective

The objective of the experimental design was to plan the computer simulation runs to provide data to answer the research questions. A description of the experimental design can be divided into four parts: control, sensitivity analysis, steady state experiments, and transitory period experiments. These will be described below.

General

Some discussion of the rationale for selecting the parameter values is necessary. First, the proportion of five to seven levels was varied over ratios of 50/50, 60/40, and 67/33. The 67/33 ratio is approximately the ratio in the four original AFSCs. It is, therefore, a good starting point. Altering this ratio to 50/50 and 60/40 essentially changes promotion opportunity. The greater number of seven levels means that their losses will be greater. This, in turn, increases five level upgrade and promotion opportunities. Therefore, the three ratios simulate the possibility that it might be desirable to have better promotion possibility in the consolidated AFSC.

The three training throughput rates were selected on the basis of the number of personnel in the training pipeline required to produce the training throughput. The training throughputs correspond to one hundred, two hundred, and three hundred personnel in technical school during the transitory period. The maximum value, three hundred, represents a large percentage of overall manpower in the original AFSCs. The judgment, then was that the values tested represent a wide enough range to satisfy the research objective.

Finally, the manpower levels were selected primarily on the basis of the time it takes to reach the highest target manpower level. At the highest level (2500), the consolidation process would extend out to about eight years. To test higher manpower levels would take considerably longer. This research limited itself to a ten year horizon which consequently implied the manpower limit of 2500.

Steady State Experiments

The principal objective of the steady state experiments was to examine the effects of creating the consolidated AFSC across a wide range of consolidation strategies. Since there are no forecasted or estimated manpower levels for the consolidated AFSC, the experiments investigated a range of options.

These options included a wide range of total manpower levels, rates of training, and ratios of five and seven level personnel within the total manpower level. Because wide value ranges were tested, this design predicts that practical significance of the results, rather than statistical signficance of the results, will be the principal issue.

The actual design of the experiment can be represented by the three dimensional grid in Figure 7. As shown, the total consolidated AFSC manpower level was tested at levels of 1000, 1500, 2000, and 2500. Within each of these totals, the proportion of five to seven level personnel were varied at 50/50, 60/40, and 67/33 ratios.

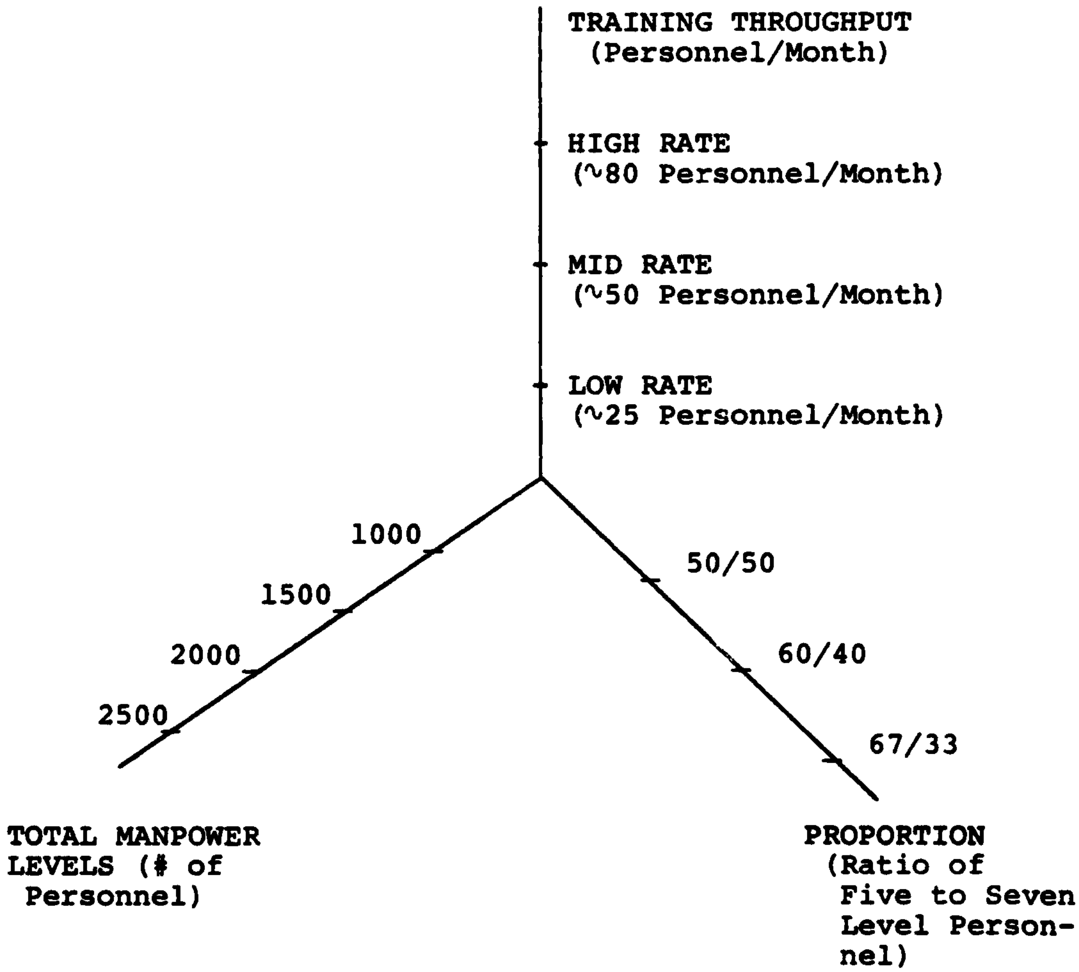


Figure 7

Experimental Design--Steady State

These first two dimensions actually yielded twelve experiments. Each of the first two factor levels were then combined with the third factor, training throughput, with one notable exception. This exception is that the lowest training rate (one hundred personnel in the school) could not be run on manpower levels above one thousand personnel.

The reason is that the loss rates would nearly exceed the training rate in cases at or above fifteen hundred personnel. Essentially, the system would never reach steady state, as previously defined. So with that exception in mind, the full experiment consisted of twenty seven cells.

From these twenty seven cells, all of the steady state results were measured. The most significant output variables are the measurements of the assignment probabilities, and the average number of personnel in the technical school.

The final design considerations were the number of runs to be made and the length of each run. Total run length varied for each cell in the experiment. The objective was to measure the variables for fifty time periods after the equilibrium period was reached. Since it took longer to reach equilibrium in some cells, total run length varied. This method, however, produced nearly identical periods for data collection in each cell.

Five runs of the simulation were made for each cell. Each run had an absolute upper limit of 120 time periods. This absolute upper limit was chosen because 120 time periods simulated ten years of activity. It is pointless to project out further than this.

Transitory Period Experiments

The transitory period research questions were more qualitative in nature. Therefore, the experiments were conducted to show the range of outcomes that are produced by various factors and to show the general shapes of the variables' respon... curves.

For all of the model runs, a single proportion (67/33) of five to seven levels was used. This proportion was selected since it is approximately the proportion used in all of the original AFSCs.

Manpower level was varied across the entire range from 1000 to 2500 personnel at a constant throughput. The effect on five and seven level assignment probability was illustrated graphically using the built-in plotting capability of the SLAM simulation language.

Then, at a particular manpower level, throughput was varied to show its effect on assignment probabilities. This was done at the fifteen hundred manpower level.

Finally, some miscellaneous runs were done to illustrate various effects such as the difference in the shape of assignment probability curves. All of the graphs were run far enough to show the transition into steady state.

Control

The purpose of this section of the experiment was to establish the baseline probabilities and assignment rates used for comparisons and model validation. Effectively, this section ran the model without turning on flows into the consolidated AFSC.

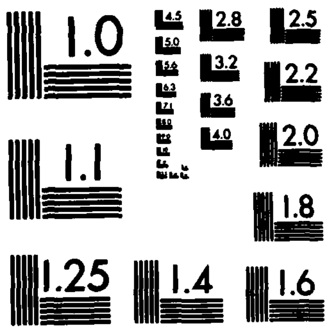
Since the results of this section were primarily compared to the steady state results, the simulation runs were done similarly. That is, there were five runs of the model and each run was for fifty time periods.

The output variables from this section were the assignment probabilities and assignment rates for the four original AFSCs at both skill levels. This provided the data for the t-tests to be conducted after the treatment (creating the consolidated AFSC). The assignment rates were available for comparison with the direct measurements (DEROS, DAS, and OSRD) taken from the AFMPC data base.

Sensitivity Analysis

Two sensitivity analyses were run on the computer model. The objective was to see how critical the measurement of input variables was to the predicted results. Consequently, tour length and loss rate were varied by plus or minus ten percent. Varying tour length essentially varied assignment rates. Assignment rates and loss rates were the two key input variables to the model.

AD-A122 848 A DYNAMIC COMPUTER MODEL TO EXAMINE SELECTED EFFECTS OF 2/3
304XX CAREER FIEL..(U) AIR FORCE INST OF TECH
WRIGHT-PATTERSON AFB OH SCHOOL OF SYTT..
UNCLASSIFIED J R LITKO ET AL. SEP 82 AFIT-LSSR-66-82 F/G 9/2 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

CHAPTER IV

THE MODEL

Introduction

This section relates the computer model to the conceptualization of the AFSC consolidation and the world views developed in Chapter I. A more technical description of the model with program listings is contained in Appendix C.

Linking the AFSC Consolidation and the World View

Assignments to and from overseas are viewed as continuous flows of personnel. Entry into and graduation from the technical school are viewed as discrete events each occurring at a point in time. The technical school, itself, is viewed as an activity extending over time.

The three statements above summarize the world views used in the computer model. The SLAM simulation language enables the modeler to conveniently mix and interact the three views. This capability is achieved by allowing three separate program modules to influence and control each other according to the modeler's plan. Each of these program modules is described below.

Network Program Module

A network consisting of nodes and interconnecting activities models the technical school operation. This is illustrated in Figure 8. Entry into the technical school is marked by a network entity passing through a node.

After passing the node that marks entry into the technical school, the class moves through an activity that represents the time between class starts. Arrival at the next node allows another class to start if further training requirements exist and school capacity is not exhausted.

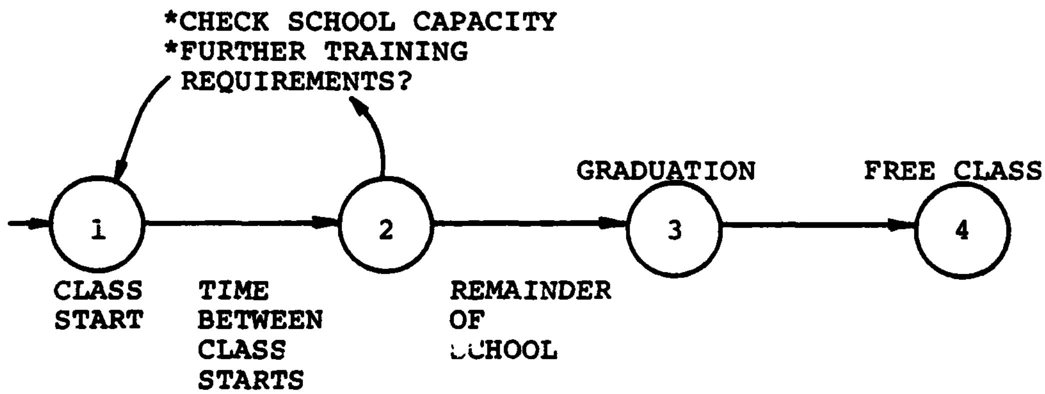


Figure 8

Modeling the Technical School

The class then proceeds down an activity that represents the remainder of the technical school, finally arriving at the graduation node. After reaching graduation, the freed class is added back into the technical school's pool of available classes.

This simple network is really a self-sustaining loop that will enter and graduate classes indefinitely. The network interacts with the rest of the program at three points. First, when classes start, manpower levels in the original AFSCs must be reduced. Second, when classes graduate, manpower levels in the consolidated AFSC must be increased. Third, prior to starting a new class, training requirements must be checked to see if more personnel are needed in the consolidated AFSC. These interactions will be described in succeeding sections.

Discrete Event Program Module

The two principal discrete events take place whenever a class enters into or graduates from training. These events occur frequently throughout each simulation run. One other discrete event exists which marks the beginning of the AFSC consolidation. This discrete event occurs only once and merely serves to establish manpower targets and allows the network described above to begin cycling. The following discussion focuses on these two principal discrete events.

Referring to Figure 8, discrete events occur at node one (entry) and node three (graduation). SLAM allows the modeler to specify what is to occur when certain nodes are passed. In this case, the manpower levels of the original and consolidated AFSCs are adjusted.

At entry, a portion of the total class size is deducted from the manpower strength of each AFSC at the five and seven levels. The number deducted is determined using the earlier assumption that each AFSC contributes to the consolidated AFSC in proportion to its own size.

At graduation the total number of five levels and total number of seven levels in the class are summed. These numbers are added to the consolidated AFSC at the five and seven levels respectively.

This procedure produces a stair step effect or discontinuous jump in each AFSC's manpower levels. But between each of these discontinuous jumps many other processes are occurring outside of the discrete event scenario. Assignments to and from overseas occur. Upgrades in skill and losses occur. These processes are controlled by the final program module.

Continuous Program Module

The continuous change module of the model is subroutine State. As the name might imply, the subroutine monitors and calculates the values of the state variables. In this model, the state variables are the number of personnel in each assignment category (CONUS, remote, or accompanied) for each AFSC (consolidated or original) and skill level (five or seven).

The continuous type changes to these state variables occur as a result of the assignment, upgrade, and loss rates which act over time intervals. An example illustrates this concept.

Given an assignment rate, upgrade rate, and loss rate that are to apply over a period of time, then the state variable is represented by the following equation:

$$\text{State}_{\text{now}} = \text{State}_{\text{last}} + \text{DTNOW} * (\text{assignment rate} + \text{upgrade rate} + \text{loss rate})$$

where,

$\text{State}_{\text{now}}$ = present value of State

$\text{State}_{\text{last}}$ = last value of State

DTNOW = time interval between present and last evaluation of State

An equation of this form is written for every state variable included within the model. These state variables correspond to the manpower levels of the AFSCs that were discussed earlier.

All of the state variables or levels are evaluated at simulated monthly intervals unless some discrete event occurs. Since the discrete events also cause changes to the manpower levels, the continuous changes are reevaluated whenever discrete events occur.

The preceding discussion explained how the state variables (manpower levels) are calculated and how the discrete events interact with them. In addition, the state variables interact with the network portion of the model.

Operation of the technical school (the network) is, in part, controlled by whether or not requirements exist to train more personnel into the consolidated AFSC. This requirement is monitored within the continuous portion of the model. When a shortfall of personnel exists in the consolidated AFSC, this information is passed back to the technical school to allow new classes to start. Similarly, when the shortfall is gone, new classes are prevented from starting.

Summarizing the Interactions and Functions

It would be incorrect to insist that the world views adopted here are the only correct ones for modeling the AFSC consolidation. However, there is a certain intuitive appeal to combining three separate world views into one model. Each view seems appropriate to its function and to its interactions with the other views.

Figure 9 summarizes the functions performed by each program module along with the interactions between modules. The figure also shows the circularity or feedback which characterizes the interactions of the world views. Network activities take place over time. Once completed, the network activities trigger discrete changes in otherwise continuous variables. When the continuous variables cross a threshhold (target manpower level), network activities are allowed to or prevented from starting.

One advantage of creating the model in this way is that it is now simple to modify any of its parts to suit a particular situation. One of the justifications given for the research is that several more consolidations of AFSCs may occur. This model could be easily tailored to match a

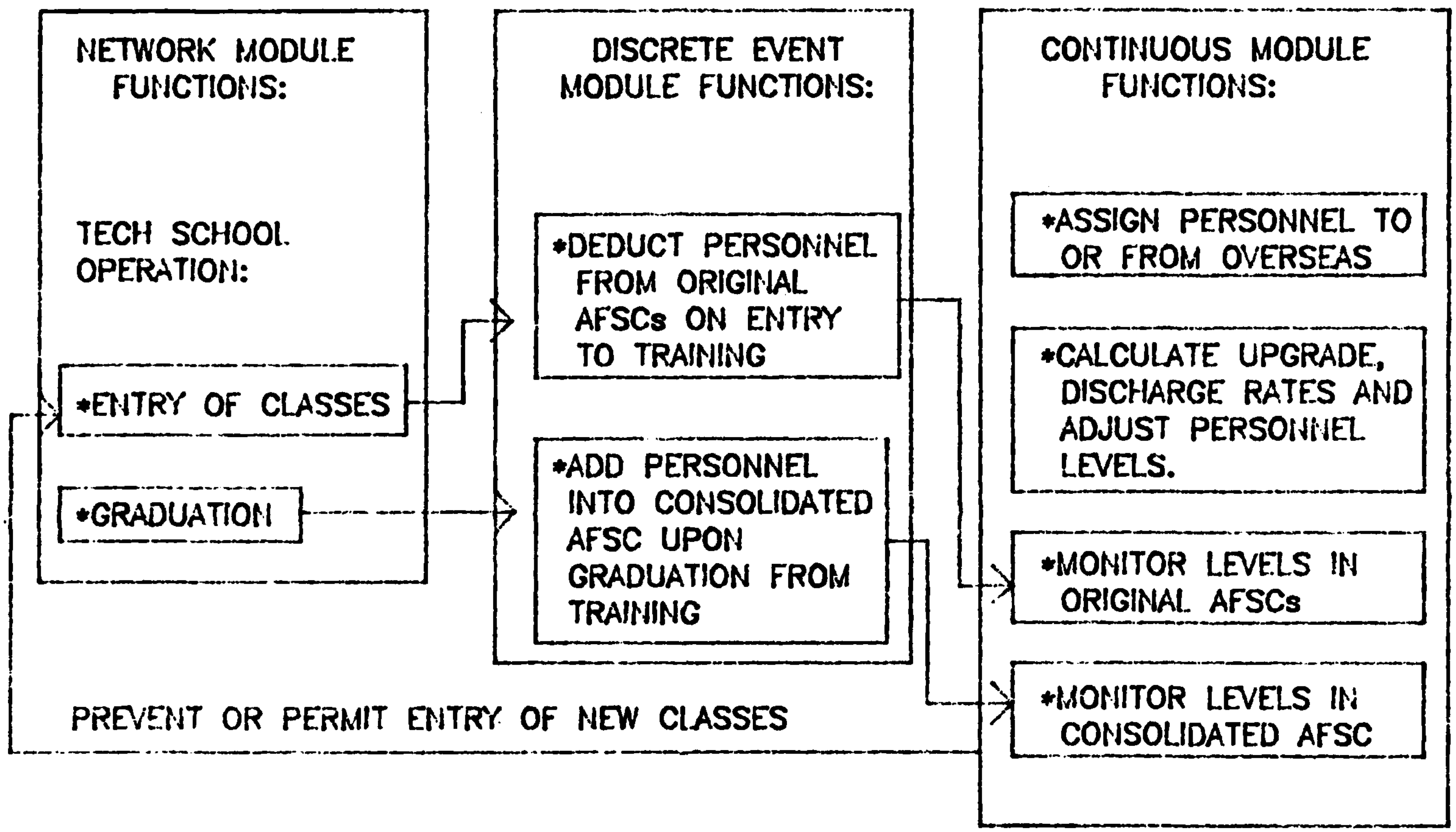


FIGURE 9

INTERACTION AND FUNCTION WITHIN THE MODEL new set of assumptions and procedures for consolidation.

CHAPTER V

RESULTS

Introduction

The results of this research are organized into sections on model validation and verification, answers to the research questions, and sensitivity analysis. In many cases, representative results are reported with complete results contained in Appendix B.

Model Verification and Validation

Verification

Verification was performed by examining graphs of selected variables over time and by examining how accurately the model tracks personnel levels. The basic model functions are to transfer personnel from the original AFSCs to the consolidated AFSC, to target personnel to imbalanced AFSCs, and to assign personnel to and from overseas.

Figure 10 illustrates the transfer of personnel into the consolidated AFSC as well as illustrating the general operation of the technical school. A step-by-step trace of the model's output was used to verify the detailed operation of the school.

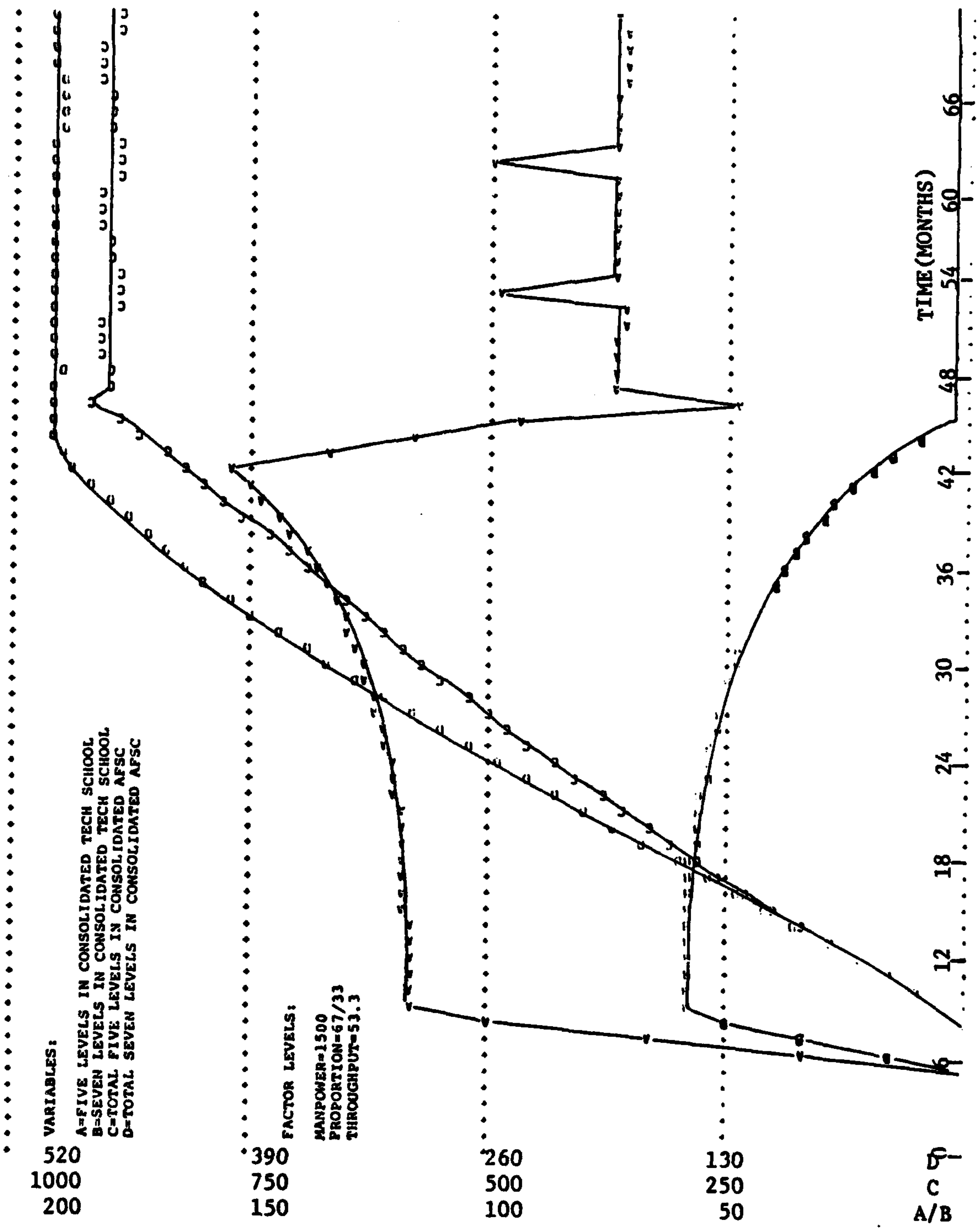


Figure 10

TECH SCHOOL OPERATION AND BUILDUP OF CONSOLIDATED AFSC

Table 2 illustrates the targeting of personnel from the consolidated AFSC to the severely imbalanced AFSCs, namely the 30450 and 30470 AFSCs. For example, the 30454 AFSC has more accompanied overseas authorizations than the 30450 AFSC. Yet, the model assigns fewer consolidated AFSC personnel to the 30454 authorizations than to the 30450 authorizations. Targeting to the imbalanced AFSCs can be seen at work throughout Table 2--for both remote and accompanied assignments.

The final model function, assigning personnel to and from overseas, is discussed in great detail during the validation of the model. Figure 11, however, is a graph showing the gradual migration of five level personnel from the consolidated AFSC to overseas. The general shape of the curves is reasonable, since the number of consolidated AFSC personnel overseas builds gradually and lags the buildup of personnel in CONUS. This is expected since the training throughput rate is greater than the assignment rate to overseas.

Validation

Model validation was approached from two objective standpoints: model operation without a consolidated AFSC and model operation with a consolidated AFSC. Additionally, the results of the model as well as its conceptual basis were briefed to personnel from the Logistics Division and Studies and Analysis Division at AFCC. This section

TABLE 2

VERIFYING THE TARGETING OF
PERSONNEL TO IMBALANCED
AFSCs

ACCOMPANIED TOURS

AFSC	BILLETS FILLED BY:		TOTALS	
	CONSOLIDATED	304XX	MODEL	ACTUAL
30450	182	595	777	779
30454	117	850	967	968
30455	3.5	65.5	69	69
30456	13	96	109	109
30470	119	195	314	313
30474	82	288	370	369
30475	3	24	27	27
30476	10	36	46	46

REMOTE TOURS

AFSC	BILLETS FILLED BY:		TOTALS	
	CONSOLIDATED	304XX	MODEL	ACTUAL
30450	32	103	135	135
30454	.8	27	27.8	28
30455	0	0	0	0
30456	4	17	21	21
30470	15	30	45	45
30474	.5	9.5	10	10
30475	0	1	1	1
30476	2	6	8	8

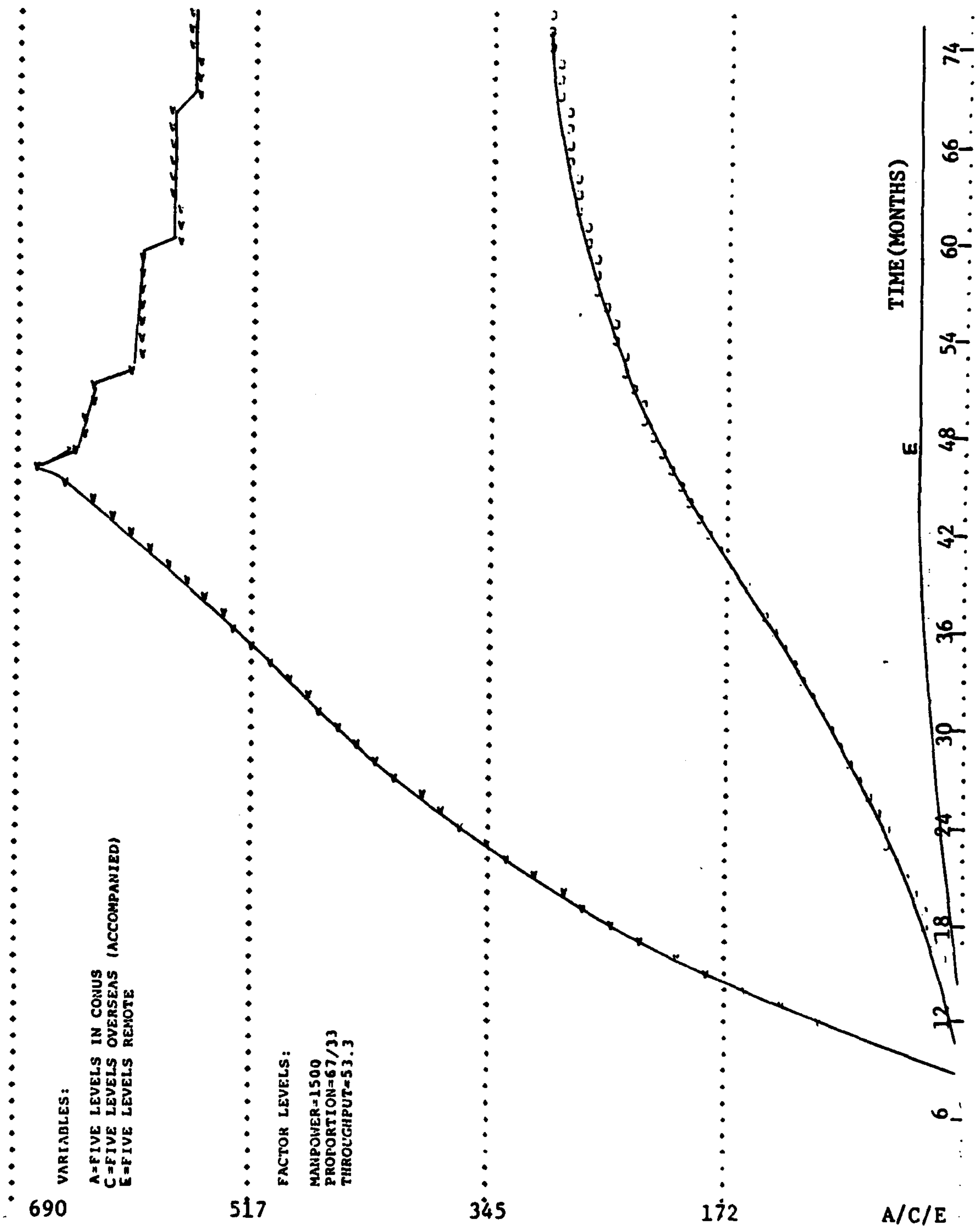


FIGURE 11

DISTRIBUTION OF CONSOLIDATED
AFSC FIVE LEVELS

reports on evaluations of model validity obtained from the above three sources.

Operation Without a Consolidated AFSC. Two indicators of validity were obtained. First, the model's predicted assignment rates were compared to real world assignment rates. Second, the manpower levels maintained by the model for each AFSC and assignment category were compared to real world manpower authorizations.

Tables 3 and 4 compare the average assignment rates, as measured in the model, to the assignment rates measured from the AFMPC data base. As stated in Chapter III, three direct measures of assignment rate exist. DEROS measures assignment rates based on expected returns. Overseas return date measures assignment rates based on returns from overseas that have actually occurred. DAS measures assignment rates based on number of personnel assigned overseas each month.

These tables report two values of assignment rate under model results. One value is based on authorized manpower, the other is based on currently assigned manpower. The purpose is to give an idea of the range of model results obtained depending on manpower level.

Table 3 shows agreement with data obtained from the DEROS and DAS. In general, the agreement is better for remote assignment rates. The probable reason is that remote tour length averages about twelve months and the

TABLE 3

COMPARING MODEL RESULTS (WITHOUT CONSOLIDATED AFSC) TO DATA OBTAINED FROM DEROS AND DAS

ACCOMPANIED ASSIGNMENT RATES (# Personnel/Month)

Sample Size: n=12 on AFMPC Data

AFSC	MODEL RESULTS		AFMPC DATA BASE			
			DAS		DEROS	
	AUTH	ASSIGNED	MEAN	STD DEV	MEAN	STD DEV
30450	23.40	19.50	23.10	7.30	22.3	8.6
30454	28.40	24.00	27.20	9.90	27.1	7.5
30455	2.15	2.24	3.10	1.40	3.1	1.7
30456	3.21	3.01	3.30	1.90	4.2	3.2
30470	8.10	8.72	9.40	4.40	11.1	5.9
30474	9.36	8.02	10.70	5.90	9.3	4.3
30475	.73	.71	.75	.62	1.0	1.0
30476	1.22	1.40	1.10	1.10	1.5	1.1

REMOTE ASSIGNMENT RATES (# Personnel/Month)

Sample Size: n=12 on AFMPC Data

AFSC	MODEL RESULTS		AFMPC DATA BASE			
			DAS		DEROS	
	AUTH	ASSIGNED	MEAN	STD DEV	MEAN	STD DEV
30450	8.90	7.60	7.80	3.20	8.00	3.5
30454	2.34	1.90	1.80	1.70	1.75	1.7
30455	N/A	N/A	N/A	N/A	N/A	N/A
30456	1.74	1.49	1.40	1.20	1.40	1.4
30470	3.10	3.30	3.50	3.00	3.80	2.7
30474	.77	.77	.75	.75	.60	.7
30475	.09	.08	.08	N/A	.08	N/A
30476	.67	.58	.58	.66	.42	.5

TABLE 4

COMPARING MODEL RESULTS WITHOUT CONSOLIDATED AFSC TO DATA OBTAINED FROM OVERSEAS RETURN DATE

Aggregate Remote and Accompanied Assignments*
(# Personnel/Month)

AFSC	MODEL RESULTS		AFMPC DATA BASE	
	AUTHORIZED	ASSIGNED	MEAN	STD DEV
304X0	43.50	39.20	41.30	14.0
304X4	40.80	34.70	39.80	11.4
304X5	2.97	3.05	3.67	3.2
304X6	6.85	6.50	5.08	1.6

Sample Size: n = 12 on AFMPC data

* Data obtained from overseas return date can not be separated according to remote and accompanied assignment rates. Returnees were not categorized by type of assignment in the data obtained from AFMPC.

AFMPC data used for validation represents a sample of twelve consecutive months.

On the other hand, the accompanied tour length averages about thirty six months. As with remote tours, the AFMPC data used for validation covers twelve months. A strong possibility exists that the remaining twenty four months of data would pull the averages closer to the model's prediction.

In any case, the model calculates assignment rates using average tour length. This produces an average based on a complete cycle of assignments equal to the average tour length. With this in mind, the agreement is good and is certainly within the statistical variance of the real world data.

Table 4 compares model results to AFMPC data based on overseas return dates. As in the case of DEROS, the predicted model values agree with the real world data.

The comparison had to be made on the basis of total five and seven level assignments for total remote and accompanied assignments. This was done for two reasons. First, the AFMPC data does not separate overseas returns by assignment category. Second, an individual could have returned as a five level and subsequently upgraded skill level since returning. The record would then be listed under seven level returns when, in fact, the return occurred while the individual was a five level.

Table 5 shows that the model keeps personnel levels equal to authorized strength or assigned strength according to the modeler's desires. The left portion of Table 5 compares model results to authorizations for a model run using authorized strength. The right portion of this table compares model results to assigned personnel for a model run using assigned strength.

<u>Operation with a Consolidated AFSC</u>. Some aggregation of results is required to compare assignment rates from the model to assignment rates from the real world data. Assignment rates in the model are now

TABLE 5

COMPARING MODEL RESULTS TO ACTUAL MANPOWER LEVELS

Accompanied Tours

AFSC	MODEL	AUTHORIZED	MODEL	ASSIGNED
30450	779	779	650	650
30454	968	968	819	819
30455	69	69	72	72
30456	109	109	102	102
30470	313	313	337	337
30474	369	369	316	316
30475	27	27	30	30
30476	46	46	53	53

Remote Tours

AFSC	MODEL	AUTHORIZED	MODEL	ASSIGNED
30450	135	135	116	116
30454	28	28	23	23
30455	0	0	0	0
30456	21	21	18	18
30470	45	45	48	48
30474	10	10	10	10
30475	1	1	1	1
30476	8	8	7	7

composed of a component from the consolidated AFSC and a component from the original AFSCs. Therefore, the model data presented in Tables 6 and 7 represent the sum of the consolidated AFSC and original AFSC components.

The agreement is well within the variance of the measured data from AFMPC. However, there is one systematic effect which would tend to make real world assignment rates

TABLE 6

COMPARING MODEL RESULTS (WITH CONSOLIDATED AFSC) TO DATA OBTAINED FROM DEROS AND DAS

Accompanied Assignment Rates (# Personnel/Month) — Sample Size: n = 12 on AFMPC data

AFSC	MODEL RESULTS		AFMPC DATA BASE			
			DAS		DEROS	
	AUTH	ASSIGNED	MEAN	STD DEV	MEAN	STD DEV
30450	23.70	20.30	23.10	7.30	22.3	8.6
30454	28.50	24.50	27.20	9.90	27.1	7.5
30455	2.20	2.30	3.10	1.40	3.1	1.7
30456	3.20	3.00	3.30	1.90	4.2	3.2
30470	7.70	7.70	9.40	4.40	11.1	5.9
30474	9.20	7.60	10.70	5.90	9.3	4.3
30475	.72	.78	.75	.69	1.0	1.0
30476	1.20	1.30	1.10	1.10	1.5	1.1

Remote Assignment Rates (# Personnel/Month) — Sample Size: n = 12 on AFMPC data

AFSC	MODEL RESULTS		AFMPC DATA BASE			
			DAS		DEROS	
	AUTH	ASSIGNED	MEAN	STD DEV	MEAN	STD DEV
30450	9.00	7.80	7.80	3.20	8.00	3.5
30454	2.30	1.90	1.80	1.70	1.75	1.7
30455	N/A	N/A	N/A	N/A	N/A	N/A
30456	1.75	1.50	1.40	1.20	1.40	1.4
30470	3.00	3.20	3.50	3.00	3.80	2.7
30474	.77	.74	.75	.75	.60	.7
30475	.08	.08	.08	N/A	.08	N/A
30476	.66	.57	.58	.66	.42	.5

TABLE 7

COMPARING MODEL RESULTS (WITH CONSOLIDATED AFSC) TO DATA OBTAINED FROM OVERSEAS RETURN DATE

Aggregate Remote and Accompanied Assignments*
(# Personnel/Month)

AFSC	MODEL RESULTS		AFMPC DATA BASE	
	AUTHORIZED	ASSIGNED	MEAN	STD DEV
304X0	43.4	39.00	41.30	14.0
304X4	40.7	34.70	39.80	11.4
304X5	3.0	3.16	3.67	3.2
304X6	6.8	6.40	5.08	1.6

Sample Size: n = 12 on AFMPC data

* Data obtained from overseas return date can not be separated according to remote and accompanied assignment rates. Returnees were not categorized by type of assignment in the data obtained from AFMPC.

measured from DEROS appear larger than model predictions. This effect is that of tour extensions.

A certain percentage of individuals elect to extend their tours. This is usually done in the last year of the tour. The net effect of tour extensions would be to push some returnees out beyond the twelve month window through which DEROS was averaged. This would reduce the average number of returnees per month as measured by the AFMPC data. If this effect could be taken into account, the agreement with the model result in each case would increase.

Table 2 at the beginning of this chapter illustrates the model's ability to track personnel levels accurately with the consoidated AFSC operating in the model. Thus, the model can accurately maintain manpower levels as well as produce representative average assignment rates.

Subjective Evaluations

Appendix E contains comments received from Air Force Communications Command personnel who were briefed on the computer model. These comments help support the face validity of the model and were also used to form recommendations for future research. Comments received in typed form are included as is. Handwritten comments were transcribed verbatim.

The comments were mainly elicited regarding the structural model of the AFSC consolidation. The intent in doing this was to ensure the model captured the essence of the consolidation proposal being studied. The personnel briefed were neither computer nor personnel specialists, but were knowledgeable of the AFSC consolidation proposal. Therefore, their opinions were most valuable in regard to the structural model of the AFSC consolidation.

One criticism pointed out the need to clarify the actual drawing and description of the structural model regarding the consolidated AFSC personnel in CONUS. Specifically, consolidated AFSC personnel have no slots of their own either overseas or in CONUS. They occupy only the slots of the other four AFSCs. An effort was made to make this point clearer in this research.

In general, the structural model, the use of assignment flows and probabilities, and the model's predictions were favorably received. Other comments regarding assumptions and other possible areas for study were beyond the scope of this research. Some of these comments were incorporated into the recommendations presented in Chapter VI.

Answering the Research Questions

Research Question One

How would various manpower levels in the consolidated AFSC affect the assignment probabilities in the four original AFSCs and the consolidated AFSC itself?

Three sets of statistical tests were used to answer this question. First, Kolmogorov-Smirnov tests were conducted to verify that average values were normally distributed. These tests are reported in Appendix B. To summarize here, the average probability values show an excellent fit to the normal distribution.

Second, t-tests were conducted to compare the mean of the assignment probabilities without a consolidated AFSC (baseline value) to the mean of the assignment probabilities with a consolidated AFSC (treatment values). The full results of the t-tests and the average probability values for each AFSC and skill level are presented in Appendix B. Representative results are discussed in the following paragraphs.

Third, an ANOVA was used to examine the various factor levels for possible two and three way interactions. These results are also presented in Appendix B.

Although the full results are in Appendix B, some representative results are shown here. Figure 12 through Figure 15 summarize the average assignment probabilities for several model runs. All figures use the same training throughput rate and proportion of five to seven levels. Therefore, the main treatment, varying total manpower, is visible.

Overall, the model predicts that some AFSCs will profit by consolidation and others will get somewhat higher overseas assignment probabilities. This is not a surprising result and it contributes to the face validity of the model. Since overseas requirements do not change, some AFSCs must pay for the improvement to the 30450 and 30470 assignment picture.

What is interesting is that the model results indicate that the five levels will provide most of the improvement to the seven level AFSCs. Figure 13 shows that all sevel level AFSCs benefit from the consolidation at higher manpower levels. Figure 15 shows that the 30474 AFSC experiences only a small increase in remote assign-

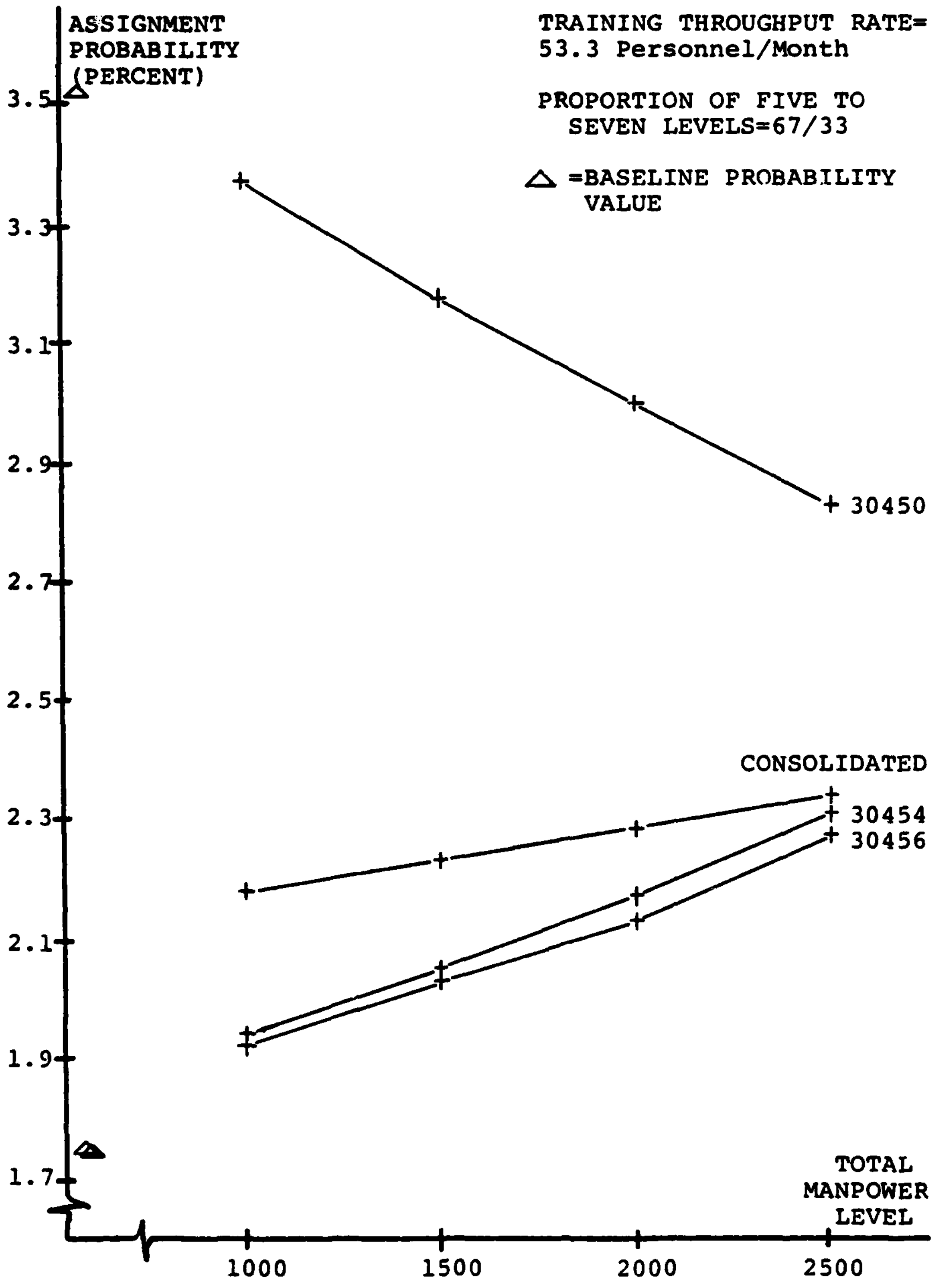


Figure 12
Five Level Accompanied Assignment Probability

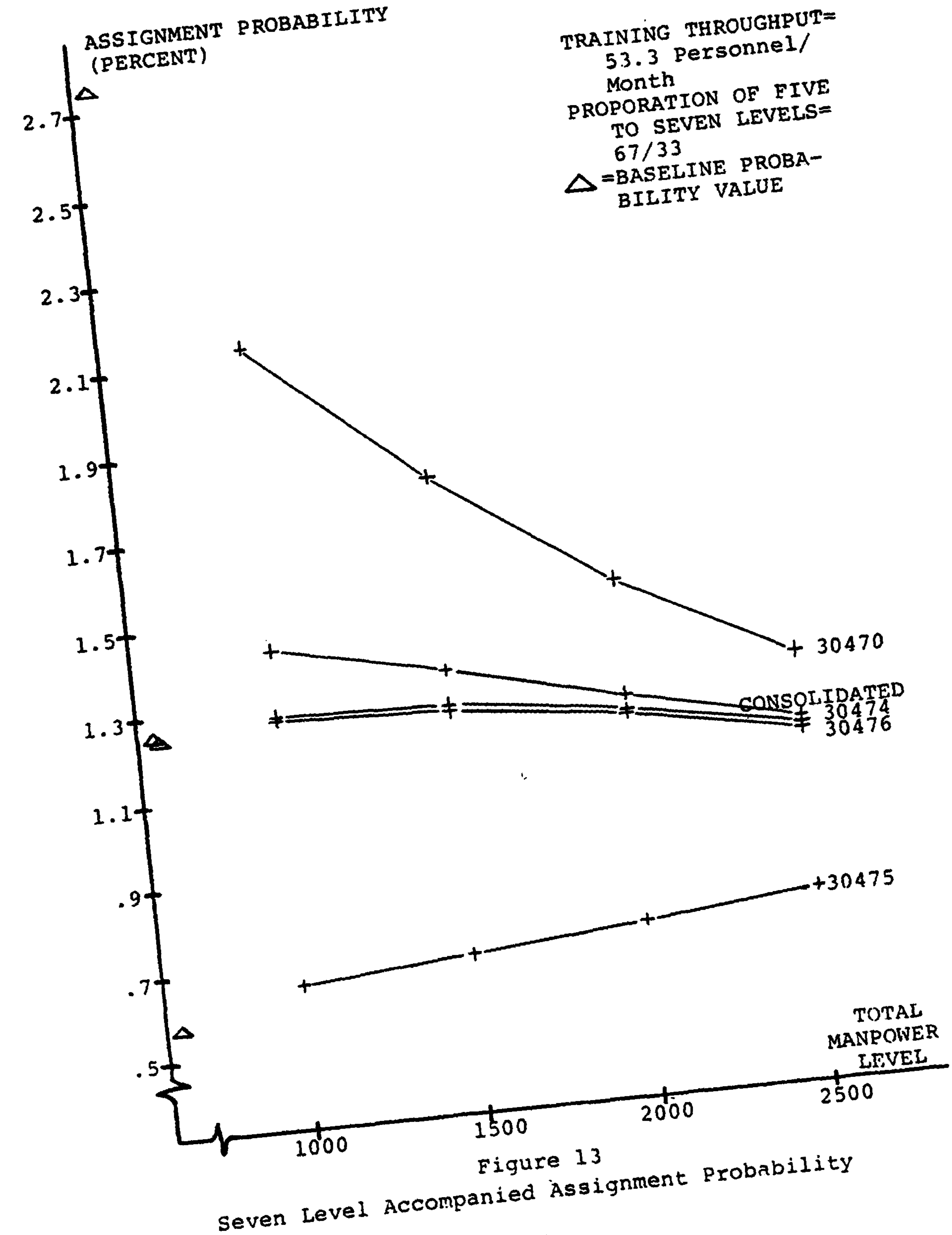
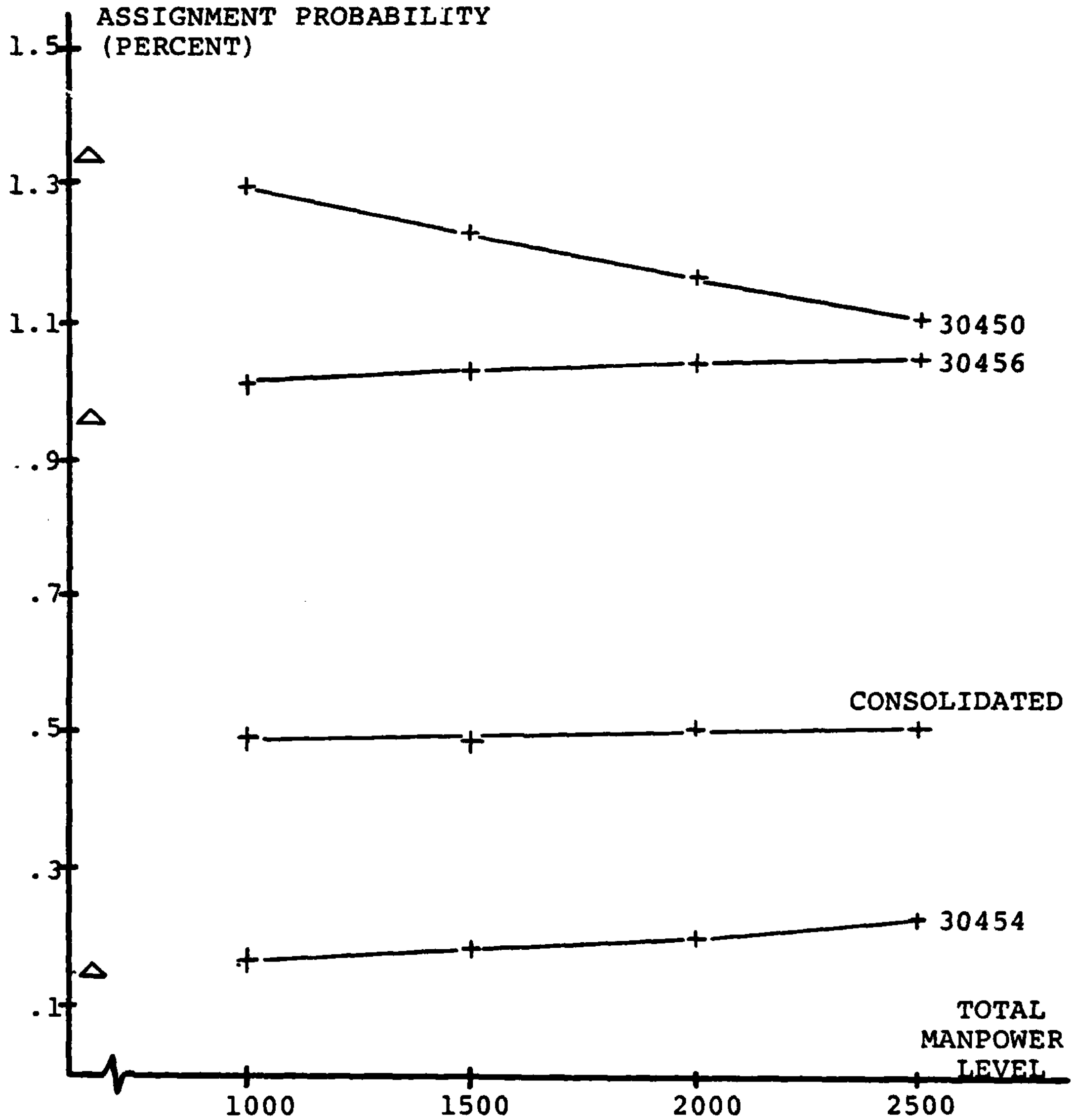


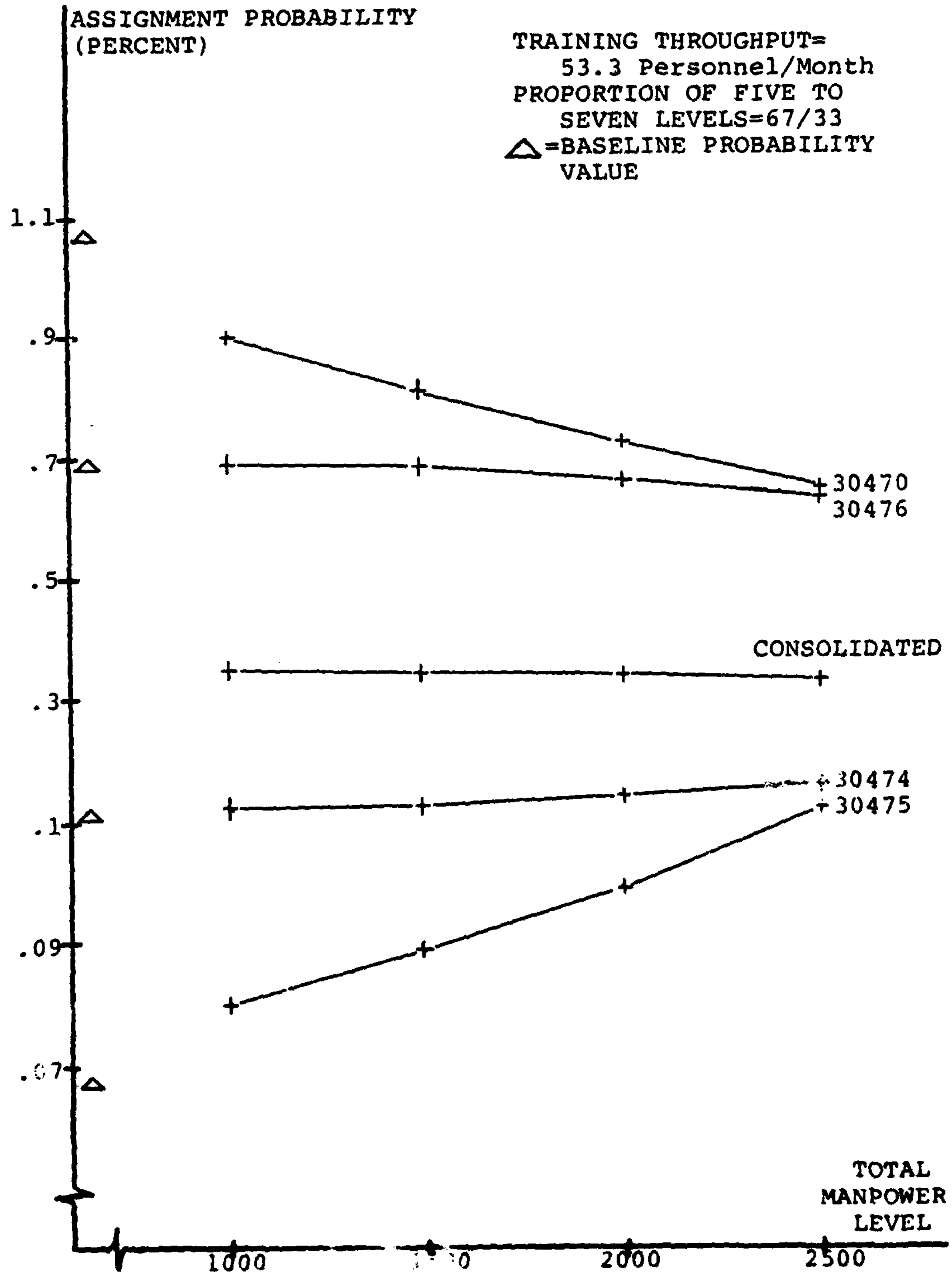
Figure 13
Seven Level Accompanied Assignment Probability



TRAINING THROUGHPUT = 53.3 Personnel/Month
PROPORTION OF FIVE TO SEVEN LEVELS - 67/33
△ = BASELINE PROBABILITY VALUE

Figure 14

Five Level Remote Assignment Probability



[illegible]ure 15

Seven Le[illegible]e Assignment Probability ment probability.

That leaves as the prime contributors to improvement the 30454, 30456, and the consolidated AFSC. This is shown in Figures 12 and 14. There are two reasons why the five levels contribute to improvement at both skill levels: skill upgrade and training overhead.

According to the model, few seven level personnel are required in the technical school from the original AFSCs once equilibrium is reached. Seven level requirements (to replace losses) in the consolidated AFSC are largely met by upgrading its own five level personnel. Consequently, there is virtually no training overhead for seven levels once the steady state period is reached. This would tend to leave seven level assignment probabilities more constant across all AFSCs.

Skill upgrade occurs in the model both overseas and in CONUS. Upgrades to the seven level overseas tend to reduce assignments for seven levels currently in CONUS. One other factor enters also. There are twice as many five as seven levels overseas. This means that a significant proportion of seven level assignment requirements are offset by five level upgrades.

One final observation will be made. Under certain circumstances, the model predicts that the 30450 assignment probability will not improve. This happens at a low total manpower level (one thousand), an even division of five and seven levels (50/50), and a high throughput rate. This is, however, the only case where 30450 assignment probability does not improve. It represents the worst combination of factors and these factors all conspire to worsen the situation. The high throughput adds a considerable training overhead. The low total manpower of five hundred five levels in the consolidated AFSC is not sufficient to offset this drag.

With this exception all other treatments improve 30450 assignment probabilities. The improvement ranges from zero to twenty percent reduction in the probability of accompanied overseas assignment, and zero to seventeen percent reduction in the probability of remote assignment.

The 30470 accompanied assignment probabilities are reduced by a range from twenty to sixty-eight percent. The 30470 remote assignment probabilities are reduced over a range from seventeen to sixty-two percent.

Research Question Two

What is the training throughput rate necessary to sustain a given consolidated AFSC manpower level?

The overall training requirement, in terms of number of personnel per month, can be read from Figure 16. Only the total manpower level has a really significant effect on the training requirement. For the most part, the training requirement is simply equal to the overall monthly loss rate (about one and a half percent) times

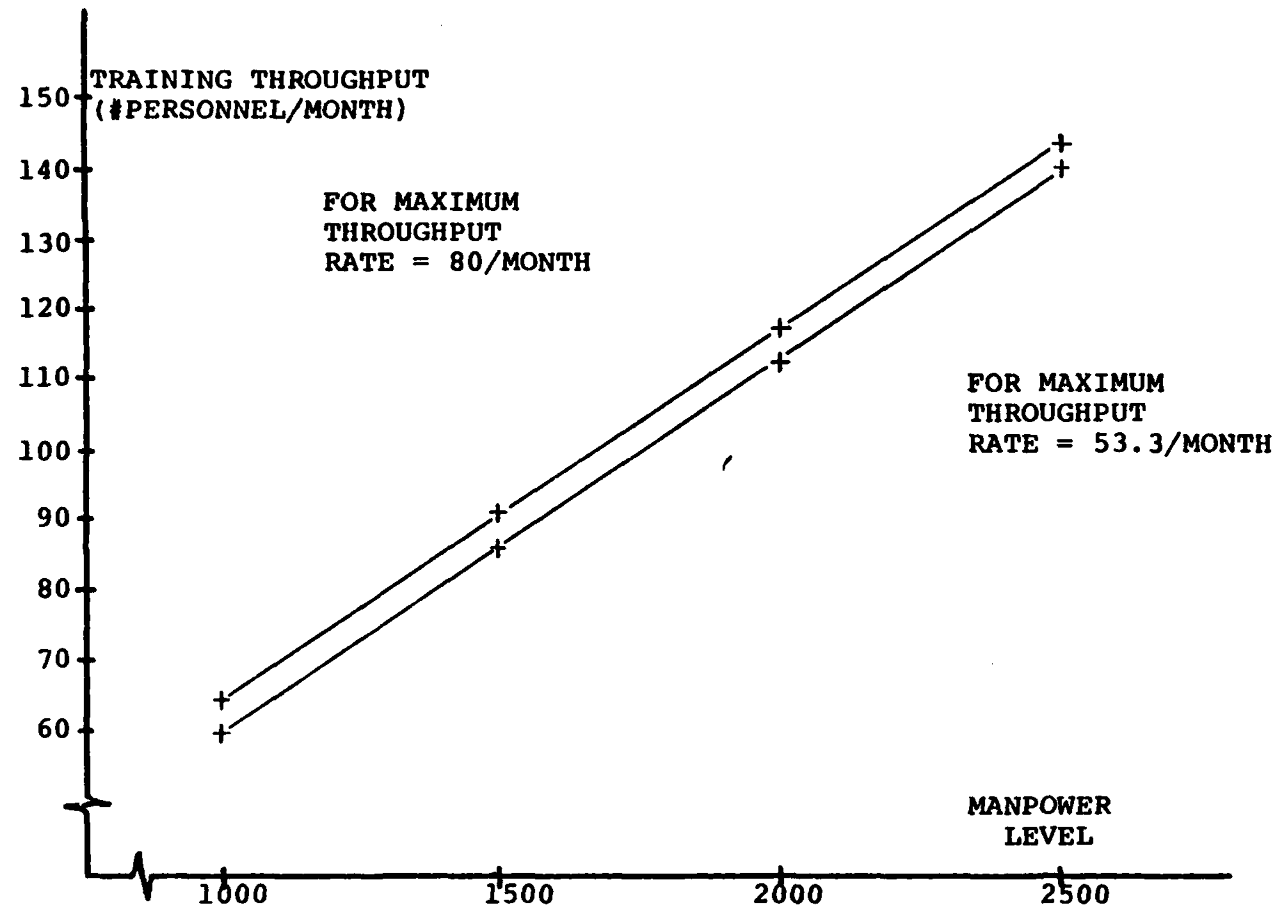


Figure 16

Training Throughput Required During
the Steady State Period

the total manpower level.

Figure 10 presented earlier in the chapter, shows how the composition of the technical school shifts over time. Initially, there are equal numbers of five and seven level attendees. But when the steady state (equilibrium point and beyond) is reached, virtually all attendees become five levels as skill upgrades equal seven level requirements (losses).

<u>Research Question Three</u>

How would various throughput rates and manpower levels affect assignment probabilities in the original AFSCs during the transitory period?

Figures 17, 18, 19, 20, and 21 help illustrate the answer to this question. They have been arranged sequentially so that the effect of varying parameters can be seen more clearly.

Figures 17 and 18 compare the same parameter set for the seven and five level, respectively. Then, Figures 18 through 21 compare the effect on the five level assignment probabilities when target manpower level is varied from twenty-five hundred down to one thousand. Finally, Figures 21 and 22 show the effect of varying the throughput rate with all other parameters held constant.

Figure 23 is included to illustrate a point made earlier in this thesis. Namely, assignment rates are not

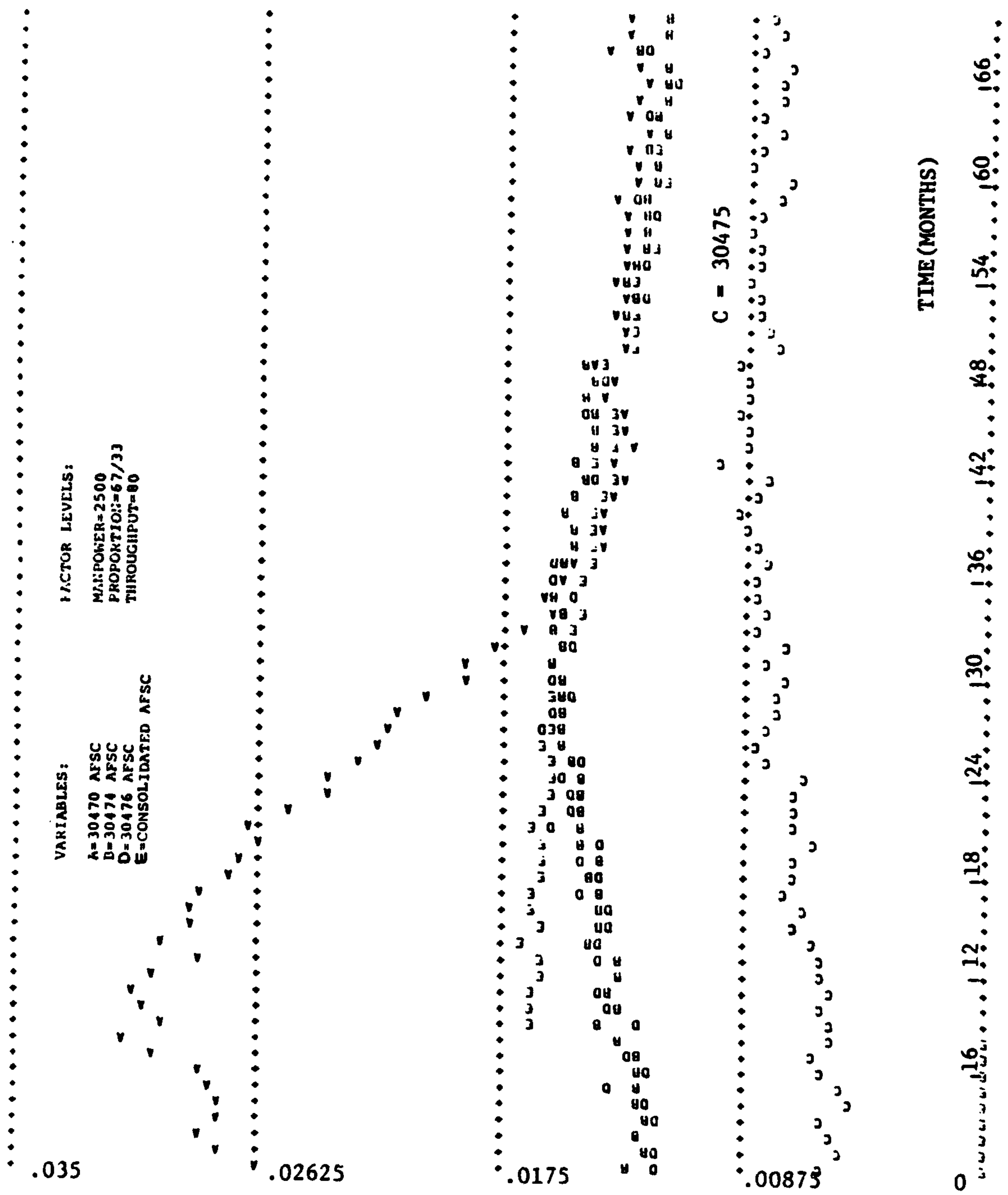


Figure 17

SEVEN LEVEL ASSIGNMENT PROBABILITIES

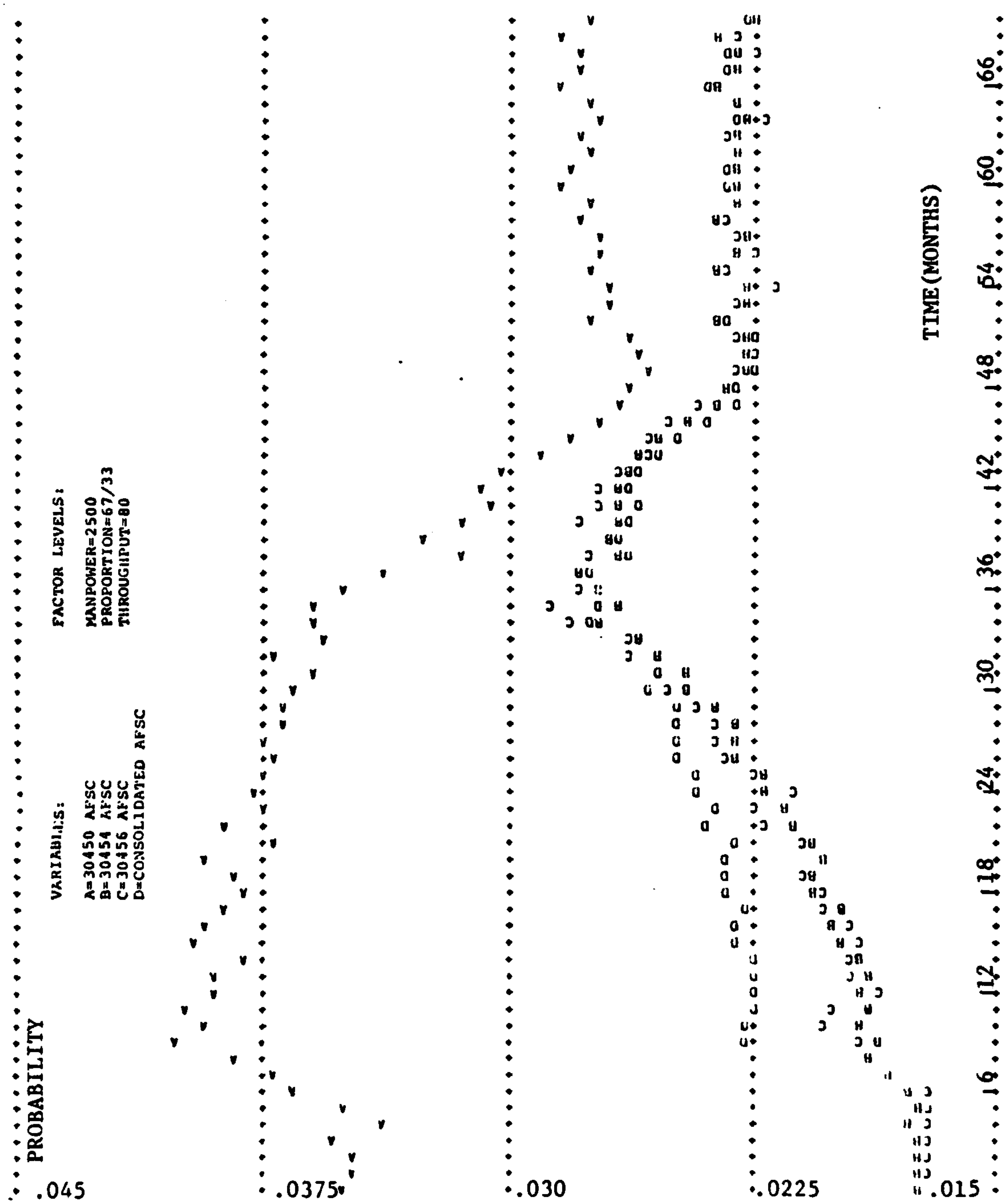


Figure 18

FIVE LEVEL ASSIGNMENT PROBABILITIES #1

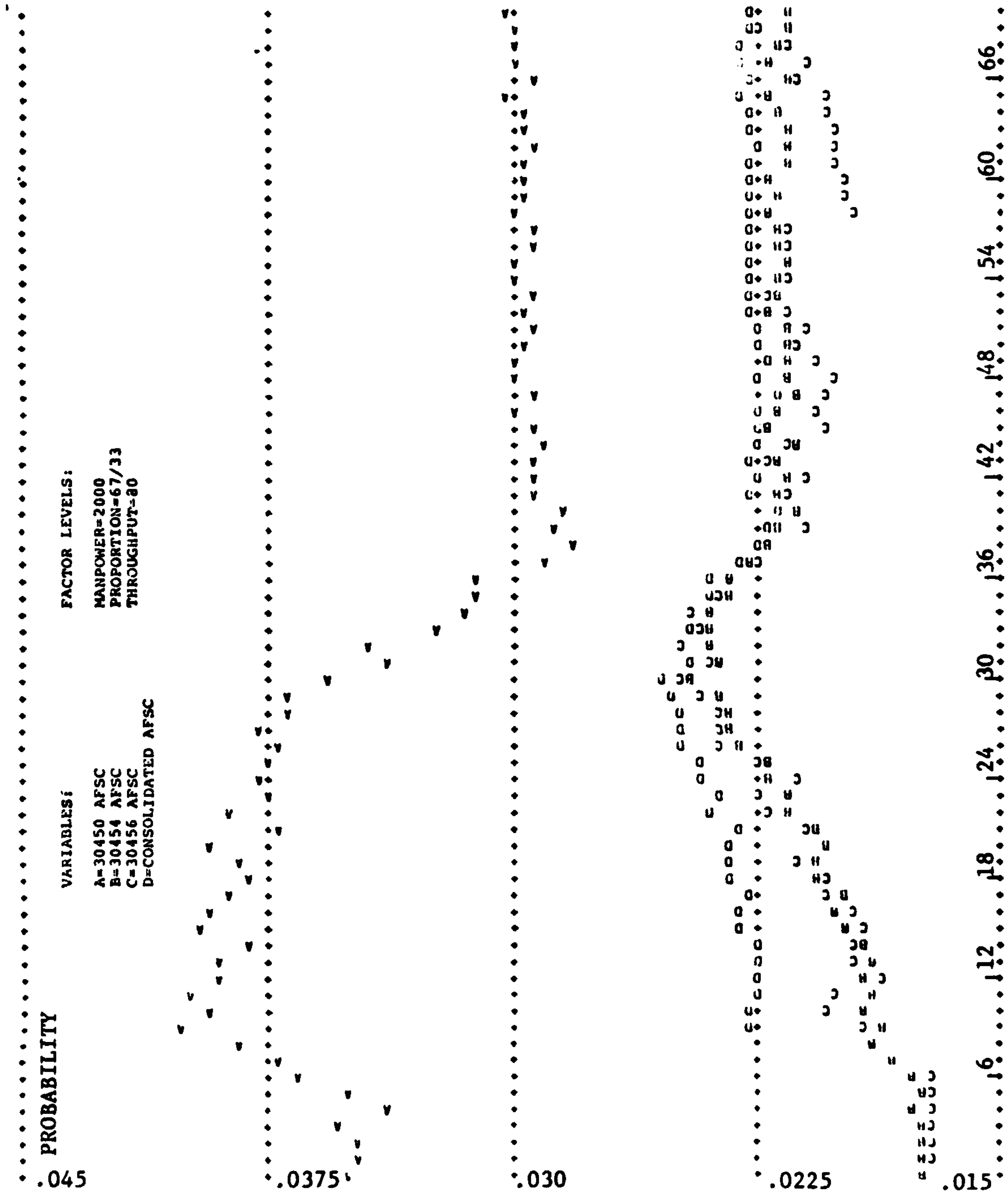


Figure 19

FIVE LEVEL ASSIGNMENT PROBABILITIES #2

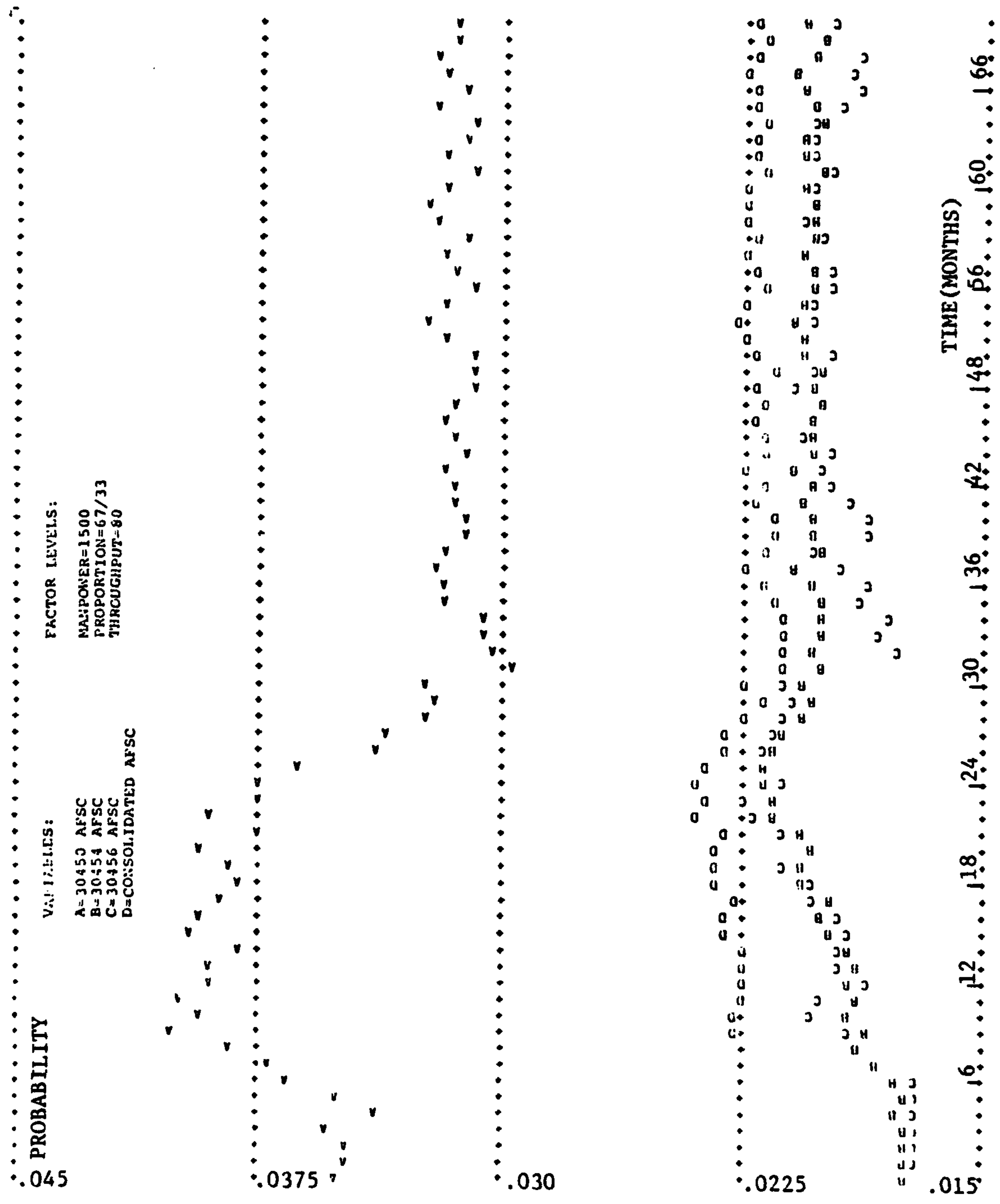


Figure 20

FIVE LEVEL ASSIGNMENT PROBABILITIES #3

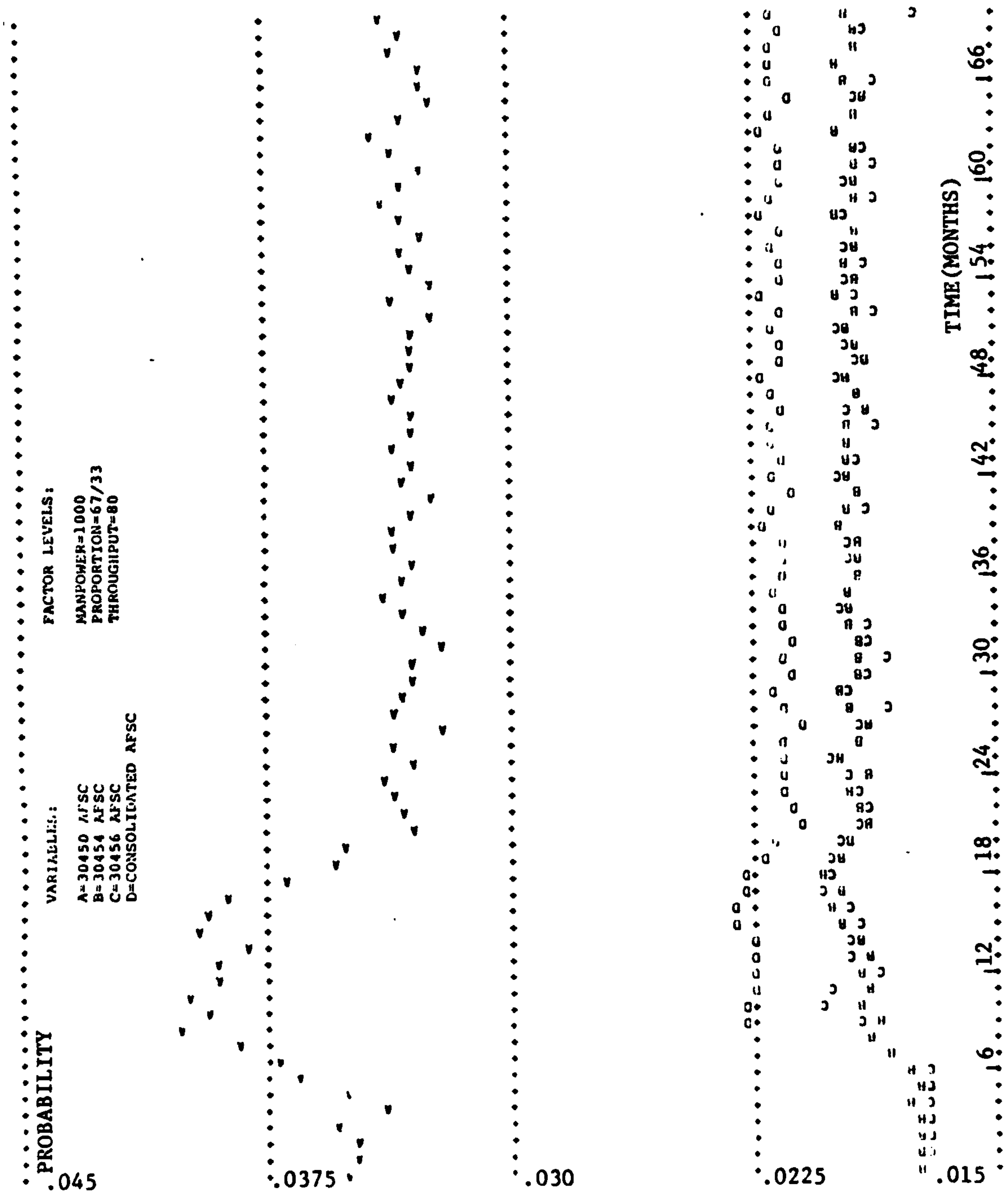


Figure 21

FIVE LEVEL ASSIGNMENT PROBABILITIES #4

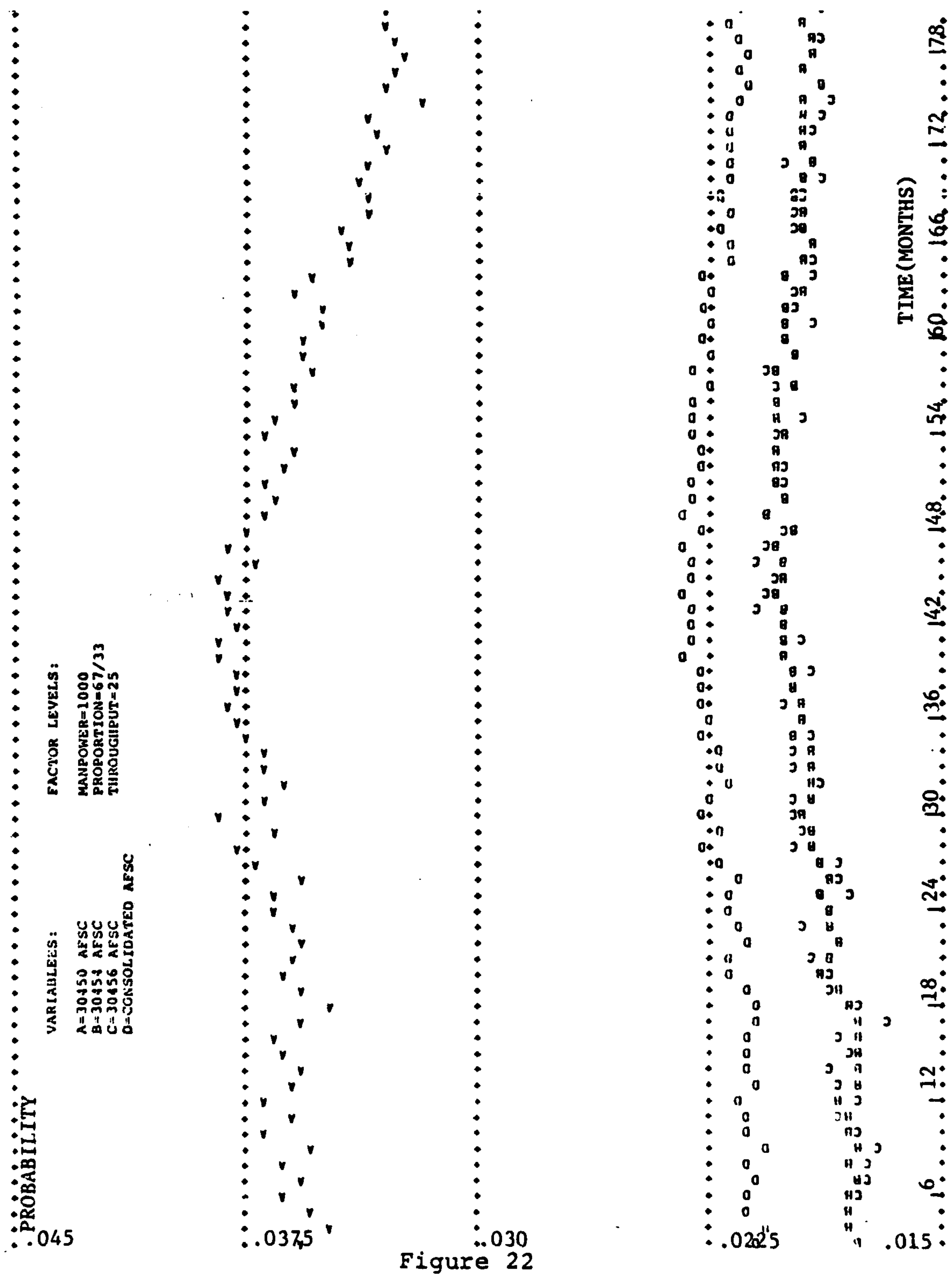


Figure 22

FIVE LEVEL ASSIGNMENT PROBABILITIES #5

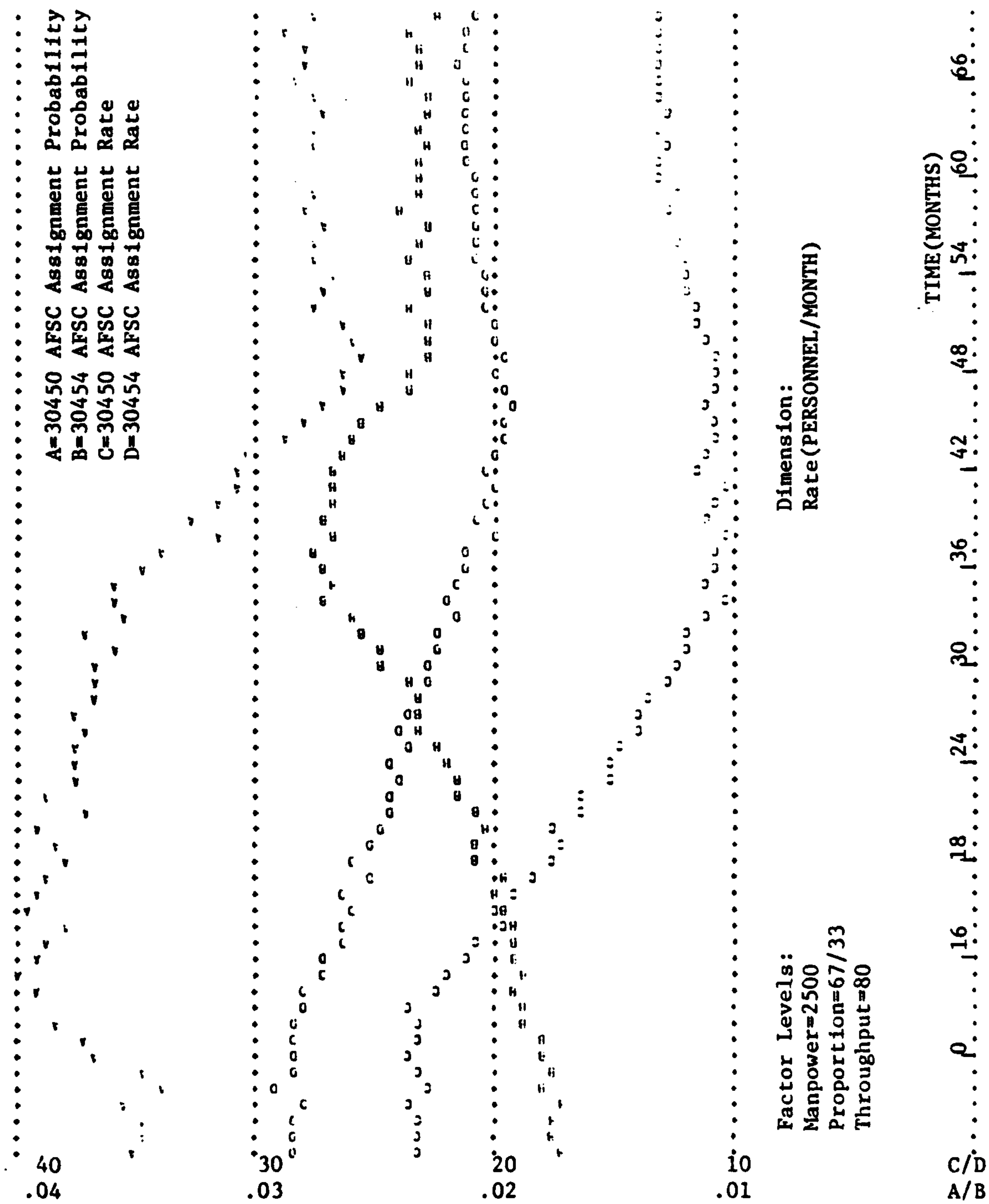


Figure 23

COMPARING ASSIGNMENT RATES AND PROBABILITIES a good indicator of the dynamics of the AFSC consolidation. It shows that assignment rates and probabilities move in opposite directions as the consolidation takes place. Lower assignment rates do not mean the situation is improving. They are offset by manpower losses to the consolidated AFSC and training overhead.

In general, the results of the transitory period follow a common sense pattern. Higher target manpower levels extend the period when assignment probabilities remain high. Furthermore, the initial worsening of assignment probabilities is intensified by higher throughput rates.

The final result for this research question regards the time required to build the consolidated AFSC to its target manpower level. This is presented in Figure 24 with a table of values also included in Appendix B.

Sensitivity Analysis

Sensitivity analysis was done to test the model's response to changing the tour lengths (and hence, the assignment rates) and the loss rates. Changes in tour length were viewed through their effect on the assignment probabilities. Changes in loss rates were viewed through their effect on the time to build to target manpower levels and the average number of personnel in the technical school.

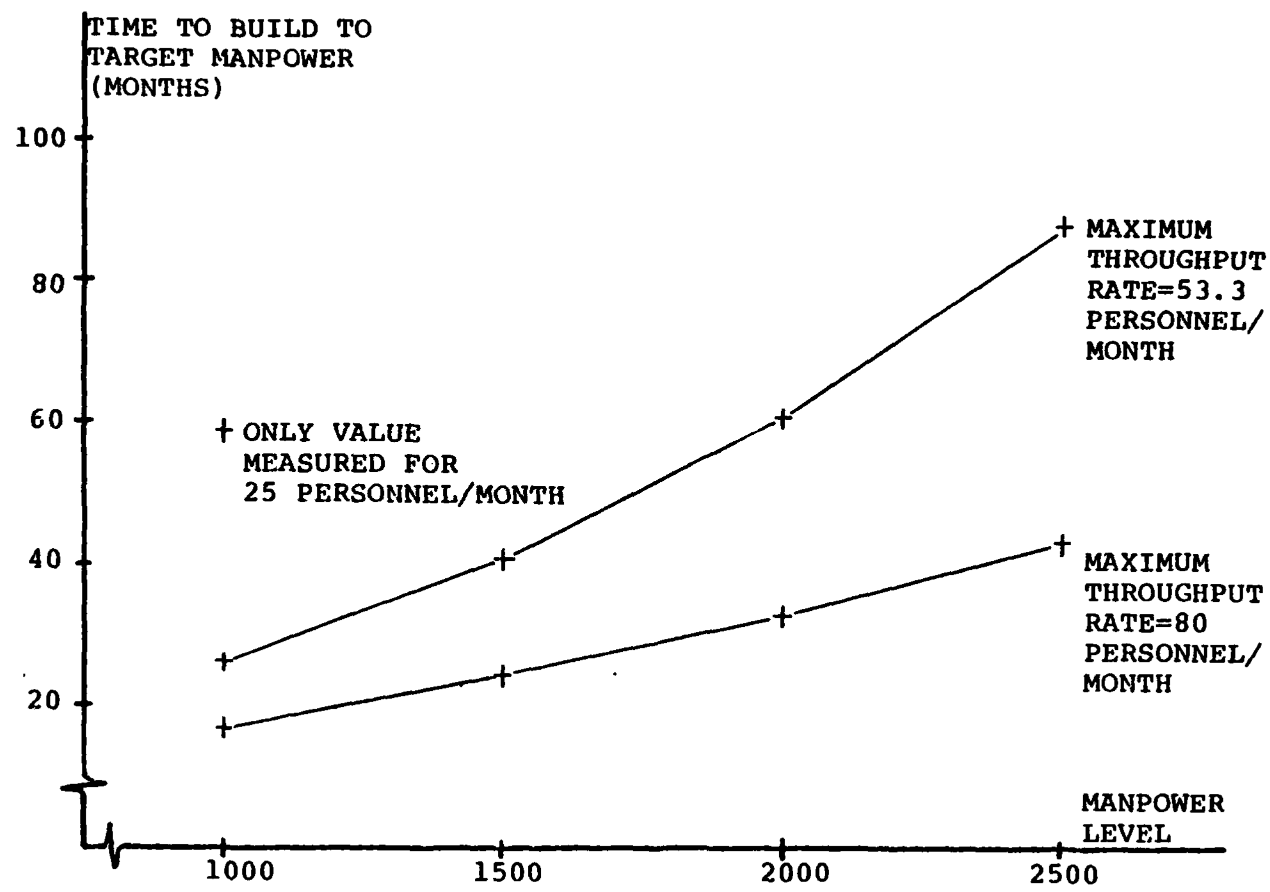


Figure 24

Time Required to Build to Target Manpower Values

Tour Length

When a consolidated AFSC is created, the model predicts a change in assignment probability. This change is the net effect of the AFSC consolidation process. This sensitivity analysis will concentrate on comparing the size of the effect when tour length is varied by plus or minus ten percent from the values used in the research.

Figures 25 and 26 illustrate the results of the sensitivity analysis for accompanied and remote assignments respectively. Both figures were developed using one set of model parameters--fifteen hundred target manpower level, 67/33 proportion of five to seven levels, 53.3 personnel/month training throughput rate. As these figures show, the model is not sensitive to common method type errors in measuring assignment rates through tour length.

Loss Rates

Varying the loss rates by plus or minus ten percent does not have an appreciable effect on measurement of the time to build the consolidated AFSC to its target manpower level. The plus or minus ten percent change causes a plus or minus 2.4 percent change in the time required to build the consolidated AFSC.

Loss rate is more directly related to average number of personnel in training. Varying loss rate by plus or minus ten percent causes the number of personnel in

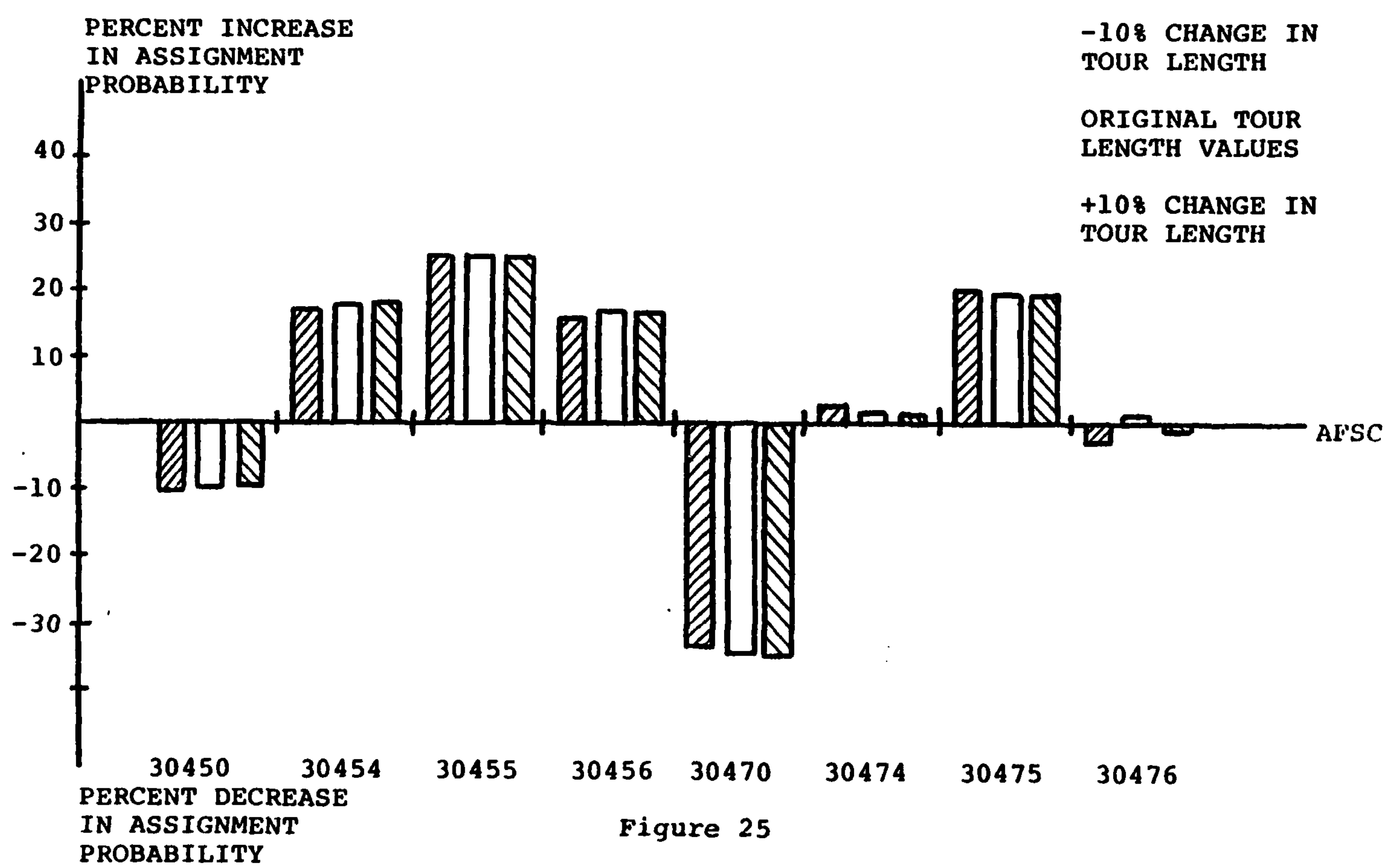


Figure 25

Model Sensitivity to Tour Length Error
(Accompanied Assignments)

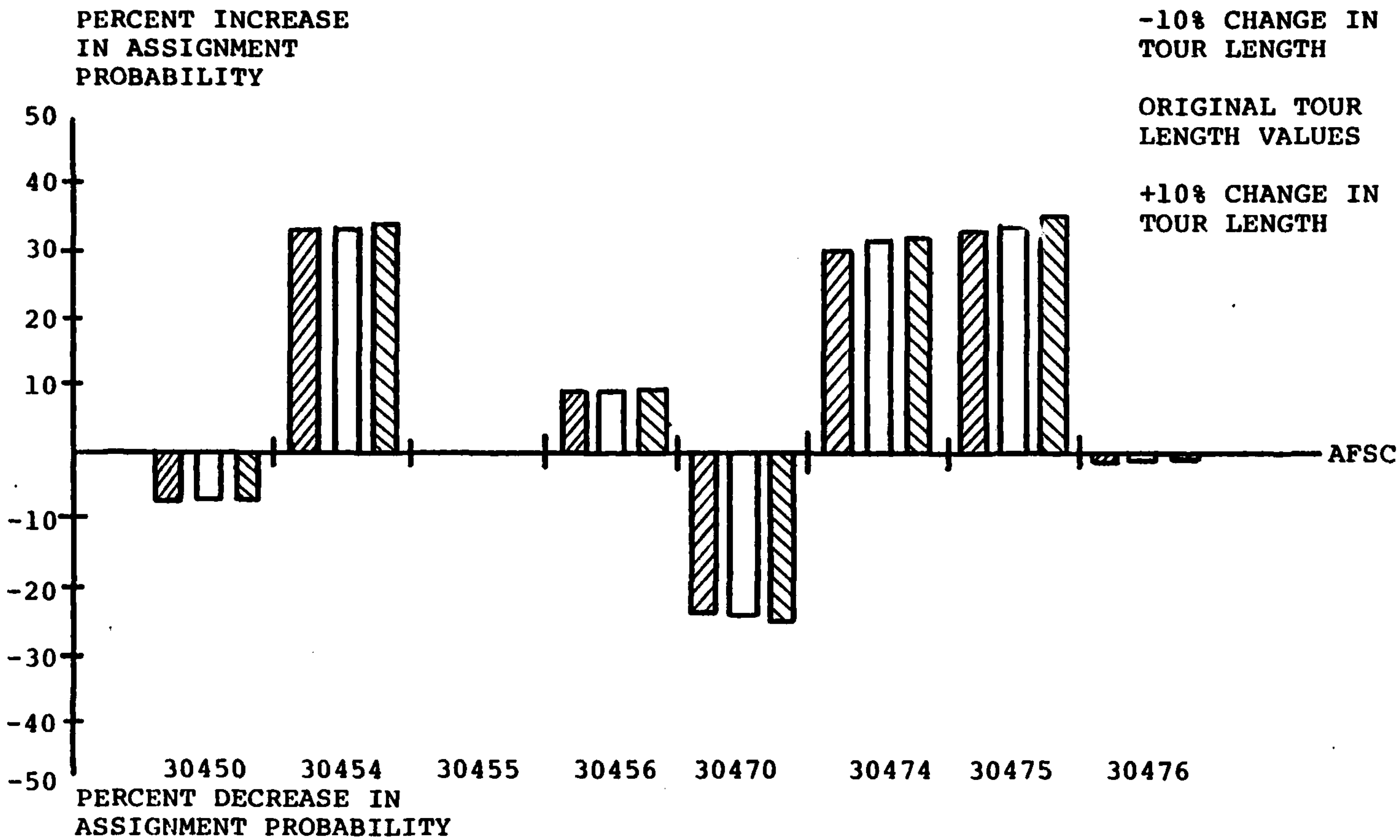


Figure 26

Model Sensitivity to Tour Length Error
(Remote Assignments)

training to vary by about 8.7 percent. The correlation between the two variables is so direct that the model must respond on a nearly one-for-one basis.

Summary

The results indicate that the model produces assignment rates that agree with averages of real world assignment rates. Furthermore, the model can accurately track personnel by AFSC, skill level, and assignment category.

The dominant effect of an AFSC consolidation would be to improve 30450 and 30470 assignment probabilities. This positive effect is not achieved without cost, however. Other AFSCs must experience an increased assignment probability to achieve the 304X0 improvement. Additionally, a transitory period exists where assignment probabilities for all AFSCs are increased.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

Introduction

Conferences on AFSC consolidation are taking place as this research is being concluded; and AFSC consolidations are likely to be an ongoing management topic for the next several years. AFSC consolidations are, therefore, current and fruitful topics for research.

In the consolidation studied here, the severe imbalance of the 30450 and 30470 AFSCs was used as a focal point for the research. The research was directed toward the problem of developing a generalized methodology for analyzing the effect of AFSC consolidations on overseas rotation and training requirements.

Within the context of the stated problem, the research objective was to quantitatively predict the effect of a 304XX consolidation on overseas rotation and training requirements. This objective was met by answering three research questions.

This chapter states the conclusions that can be drawn from the results of this research and makes recommendations for future research.

Conclusions

Research Question One

How would various manpower levels in the consolidated AFSC affect assignment probabilities in the four original AFSCs and the consolidated AFSC itself?

If one objective of an AFSC consolidation is to remedy URIs, then significant tradeoffs in assignment probabilities will result for participating AFSCs. Essentially, when one career field gains, another must lose (see Figures 12 through 15). In the actual assignment system, some formula or procedure should be used to target assistance to the oversea-imbalanced career field. In the computer model used in this research, the targeting was done explicitly in terms of the severity of the overseas imbalance.

Given this, the 304XX consolidation benefits the 30450 and 30470 AFSCs for virtually all of the consolidated AFSC manpower levels considered (see Tables 13, 17, 23, and 26). In general, most of the other AFSCs pay for this benefit by an increased assignment probability.

The model demonstrates that it is not possible to view the assignment probability tradeoffs independently for each AFSC nor for each skill level within those AFSCs. For example, improvements to 30470 assignment probabilities cannot be explained solely in terms of higher assignment probabilities for the other seven level AFSCs. There are complex interactions that complicate the analysis (see Tables 34 and 35). These interactions between skill levels are driven by training throughput (the size of the training pipeline) into the consolidated AFSC, and the proportion of five to seven skill levels in the consolidated AFSC. Assignment probabilities are affected by the proportion of five to seven level personnel through the skill upgrade process. A lower target proportion of five to seven levels in the consolidated AFSC generates a higher percentage of five level upgrades to replace seven level losses. This, in turn, causes a greater percentage of five levels to be processed through the technical school into the consolidated AFSC. Thus, on the whole, five levels in the original AFSCs suffer increased overseas assignment probabilities for the concurrent reduction of seven level overseas assignment probabilities.

Furthermore, while it is simple to predict the direction of change to the assignment probabilities in extreme cases, the direction of change is difficult to predict for AFSCs near the overall average assignment probability prior to the consolidation. For instance, the 30450 and 30470 AFSCs clearly benefit from the consolidation. The 30455, 30475, and 30454 AFSCs clearly receive increased assignment probabilities after the consolidation. However, the other AFSCs' outcomes are highly dependent on the structure of the consolidated AFSC. Therefore, if the goal of a consolidation is to eliminate or reduce URIs, management must carefully select the values of target manpower levels, training throughput rates, and proportion of five and seven level skills.

Research Question Two

What is the training throughput rate necessary to sustain a given consolidated AFSC manpower level?

Overall training requirements are simple to predict. The size of the target manpower level for the consolidated AFSC and the loss rate directly determine the training requirement. There are no subtle interactions. The training requirement is simply the product of the loss rates times the manpower base in the consolidated AFSC.

While the total training requirements are easy to calculate, the relative number of five and seven level trainees could be used by management to achieve various objectives. In this model, seven level losses were replaced by five level upgrades as is typical in the original AFSCs. Other strategies to achieve possible management objectives are discussed under recommendations for future research.

Research Question Three

How would various throughput rates and manpower levels affect assignment probabilities in the original

AFSCs during the transitory period?

Transitory effects follow a well-defined and logical pattern. For AFSCs that ultimately benefit, assignment probabilities increase initially and subsequently decrease below their current or baseline values (see Figures 17 through 21). The model shows that manpower in the consolidated AFSC must attain a specific magnitude before the drag of the training pipeline is negated. Higher training throughput rates require a greater consolidated AFSC manpower base to offset the adverse impact on assignment probabilities experienced by the original AFSCs in the early stages of consolidation (see Figures 21 and 22).

However, the size and duration of the increase in assignment probabilities can also be affected by the method used to assign personnel from the consolidated AFSC overseas. The model suggests that a good strategy may be to target assistance differently in the transitory period than during the steady state period. That is, given a certain number of consolidated AFSC personnel to be assigned overseas in a particular month, a higher percentage of these personnel should be targeted to the imbalanced AFSCs during the transitory period than during the steady state period.

Recommendations for Future Research

Expanding the Model

Adding a few additional factors and shifting closer to a systems dynamics type analysis could enhance the model developed for this research.

Factors that would be most beneficial are inclusion of upgrades and losses in the original AFSCs, the three skill level for each original AFSC, and a simulation of the accession and training pipeline to the three level. Adding these factors would expand the range of effects the model can examine.

If this were to be done, it would be better to incorporate a systems dynamics approach rather than the stochastic, primarily physical model that has been developed. There are several interface points where personnel system policy could be interjected. For example, the impact of economic factors on retention and accession, changes to promotion requirements, or changes to any of the technical training pipelines could all be modeled to measure the effect on assignments.

Although an exact statistical approach could be maintained in an expanded model, the primary thrust should be in capturing the dynamic and feedback effects that would exist. This would further contribute to understanding the career fields under study and contribute to understanding the factors that determine their stability in terms of size, skill, and experience level.

Exploring Consolidation Strategies

In conducting this research, two areas for future research were noted that involve other possible consolidation strategies. These areas which can be categorized as promotion and force structure are discussed below.

Promotion. In the computer model, all seven level losses are filled by five level upgrades. Schemes could be worked out which fill a portion of seven level losses by cross training additional seven levels from the original AFSCs. Either method would probably impact on consolidated and original AFSC promotions differently.

For instance, if some percentage of consolidated AFSC losses are filled by training additional seven levels from the original AFSCs, then five level upgrades are reduced in the consolidated AFSC. Effectively, this reduces the promotion opportunity for five levels in the consolidated AFSC and increases it in the original AFSCs by creating more seven level vacancies.

There is an additional complicating factor. Selection into the consolidated AFSC is based on having over four years time in service. Over a period of time, this will likely reduce the average experience level in the original AFSCs relative to the consolidated AFSC. This effect is not intrinsically bad since one objective of the consolidation was to produce highly trained, experienced technicians. However, there may be implications relevant to competition for promotions in the original and consolidated AFSCs that could be explored in future research.

<u>Force Structure</u>. Because there is no three skill level in the consolidated AFSC, its force structure is markedly different from the other AFSCs. A lesser number of five levels (those left in the original AFSCs) must support the upgrades to their own seven levels as well as cross training into the five level of the consolidated AFSC. This would appear feasible since the number of three levels would not decrease overall. Maintaining the correct number of five levels in the face of the increased drain becomes very critical. An expanded model could examine this area.

Summary

This research concludes that AFSC consolidations have a great potential for alleviating URIs. There are dynamic interactions associated with policy decisions necessary to implement consolidation schemes. The implications of a consolidation cannot be fully examined without a dynamic computer model such as the one presented herein.

APPENDIX A

MEASURING MODEL PARAMETERS

Three basic model parameters were obtained from the AFMPC data base. These were the average number of personnel returning from overseas per month, the average number of skill upgrades to the five level per month, and the average number of skill upgrades to the seven level per month. The measurement of each of these parameters will be discussed below.

Average Assignment Rate

As stated in Chapter III, there are four separate measures of assigment rates--DEROS, overseas return date, date arrived station, and tour length; these will be discussed in turn.

DEROS

A program referred to as "DATPRO" can be found at the end of this appendix. This program read the data supplied by AFMPC and translated it to a usable form. In the case of DEROS, converting the expected return date from YYMMDD (Year, month, day) format to an integer number of months. The number of months was referenced to an arbitrary date, in this case, 1 January 1962.

For example, May 1982 is month 245 when referenced to January 1962. January 1962 was chosen to avoid dealing with negative months for dates which would predate the reference point.

The data base was coded by AFMPC to identify all personnel by skill level, AFSC, and assignment category. Therefore, as DATPRO read each record, the record was sorted into the appropriate category. In this case, returns from remotes and accompanied tours were separated for each AFSC and skill level.

Next, a simple SPSS program was written to produce a histogram and frequency distribution for number of returnees by month. A sample of the results are shown in Table 8.

Although this data is not used directly in forming the model, averages of the number of monthly returnees are used in validating the model results.

TABLE 8

NUMBER OF OVERSEAS RETURNEES

MONTH/YEAR	CAREER FIELD		
	30450	30454	30456
Apr 82	4	14	1
May 82	15	19	6
Jun 82	30	32	4
Jul 82	15	22	5
Aug 82	27	42	8
Sep 82	34	33	2
Oct 82	28	34	3
Nov 82	23	27	2
Dec 82	15	22	1

Overseas Return Dates

Measurement of assignment rates through overseas return dates is virtually identical to the process described for DEROS. The same FORTRAN and SPSS programs were used. The only distinction is that assignments could not be categorized as remote or long tour (accompanied). The measurement represents the total of returnees from both types of assignment.

As with DEROS, the overseas return date data is not used directly in the model, but averages over a time period are used to validate the basic model performance. The use of overseas return date information supplements DEROS information.

Date Arrived Station

By counting the number of personnel who arrived overseas each month over a one-year period, a third assignment rate measure was obtained. This measurement, similar to DEROS, was categorized by type of assignment (accompanied or remote) for each AFSC and skill level. It, therefore, provided a useful cross check on the assignment rates measured from DEROS.

As explained in Chapter III, DEROS, overseas return date, and date arrived station were not used directly in modeling assignment rates because of the difficulty in sorting out cyclical components. Using both forward and backward looking data extends the time span the model can be validated against without venturing too far from the present time which is probably the most accurate and least contaminated portion of the data base. This technique also helps to average out some of the effects of the cyclical components.

Tour Length

The computer simulation model actually uses the number of personnel overseas in a given category divided by the tour length as the measure of the average assignment return rate. Therefore, the accurate measurement of tour length is essential to the research.

Program DATPRO measures the tour length of each individual by simply subtracting the date an individual was assigned overseas from his expected return date. This measurement can effectively use all of the data in the data base. It is essentially a snapshot of a few thousand assignment actions and individual decisions.

An SPSS program was used to produce a histogram and frequency distribution showing number of personnel versus tour length for each assignment category, AFSC, and skill level. Condecriptive statistics were also taken to obtain the average tour length and standard deviation.

The Central Limit Theorem was then invoked to support the fact that the average tour length is normally distributed with the mean given by the average and the standard deviation given by the standard error. The validity of this step deserves to be discussed in greater detail.

Hines and Montgomery (12:181-183) provide some rules of thumb regarding the sample sizes required to justify use of the Central Limit Theorem. They state that, in general: $n \geq 4$ is sufficient for well-behaved distributions (unimodal, bell-shaped, nearly symmetrical), $n \geq 12$ is sufficient for distributions without a prominent mode, and $n \geq 100$ should be satisfactory for ill-behaved distributions.

The frequency distributions for tour length were closely scrutinized with the above criteria in mind. Table 9 presents the number of observations included in the measurement of average tour length, for each AFSC, skill level, and assignment category.

TABLE 9

TOUR LENGTH OBSERVATIONS

AFSC	# IN TOUR CATEGORY	
	REMOTE	ACCOMPANIED
30450	116	652
30454	23	828
30455	NO REMOTE TOURS	72
30456	18	103
30470	48	339
30474	10	348
30475	1	30
30476	7	53

The small number of remote tours in some career fields seems to present the greatest obstacle to employing the Central Limit Theorem. However, an examination of the frequency distributions for the 30474, 30476, 30454, and 30456 career field remote tour lengths illustrates the reasonableness of the application. These frequency distributions are given in Table 10.

TABLE 10

FREQUENCY DISTRIBUTIONS
OF
TOUR LENGTHS

30474		30476		30454		30456	
#Obs.	Tour Length (mos)	#Obs.	Tour Length (mos)	#Obs.	Tour Length (mos)	#Obs.	Tour Length (mos)
9	12	1	11	1	10	17	12
1	24	5	12	1	11	1	13
		1	13	19	12		
				2	13		

The large number of observations in most AFSCs and assignment categories meets the general criteria of the Central Limit Theorem. In the cases where the number of observations are small, the frequency distributions are reasonably well behaved. In the case of the 30475 remote tours, there is no justification for using a normal distribution.

However, because the 30475 remote category is so small it cannot have much impact on the overall simulation. The modeling expedience of using the same distribution for all categories, AFSCs and skill levels becomes an overwhelming argument.

The final results of tour length measurements are presented in Table 11.

TABLE 11

TOUR LENGTH MEASUREMENTS

	# of Obs. Accomp/Rem	Accompanied Tour Length (mos)	Remote Tour Length (mos)
30450	652/116	33.32	15.20
30454	828/23	34.15	11.97
30455	72/N/A	31.90	N/A
30456	103/18	34.04	12.06
30470	339/48	38.70	14.54
30474	348/10	39.50	13.20
30475	30/1	37.40	12.00
30476	53/7	37.90	12.00

Skill Level Upgrades

Skill upgrade can only occur after an individual has attained a certain rank. For instance, nine levels must be senior or chief master sergeants and seven levels must be technical or master sergeants. It is not surprising, therefore, that the number of skill upgrades in a given month display some cyclical trends which may, in fact, be tied to promotion cycles.

The number of skill upgrades per month also display some obvious management efforts to maintain manpower levels at prescribed targets. There are large humps in five level upgrades followed by valleys as if to show a guildup in manpower.

Regardless of the origin or cause of these cycles, their presence is not critical to the functioning of the model. First, they are used to infer average loss rates which are, in turn, used to predict long term average training requirements.

Second, skill level upgrades permit the passage of personnel between the five and seven skill level of the consolidated AFSC. The purpose of this is to acknowledge that a large portion of seven level requirements will be filled by upgrade rather than by cross-training from the original AFSCs.

Therefore, it is entirely adequate to the purposes of the model to work with an average upgrade rate. The averages for five and seven level upgrades were taken for each AFSC over a twenty-five month period. The average number of upgrades divided by the number of personnel in the AFSC and skill level was set equal to a fractional upgrade rate, the percentage of the personnel upgrading in an average month.

The results of these measurements are shown in Table 12.

The computer model uses these upgrade rates as follows. Seven level manpower losses are set equal to the number of seven level personnel times the fractional

TABLE 12

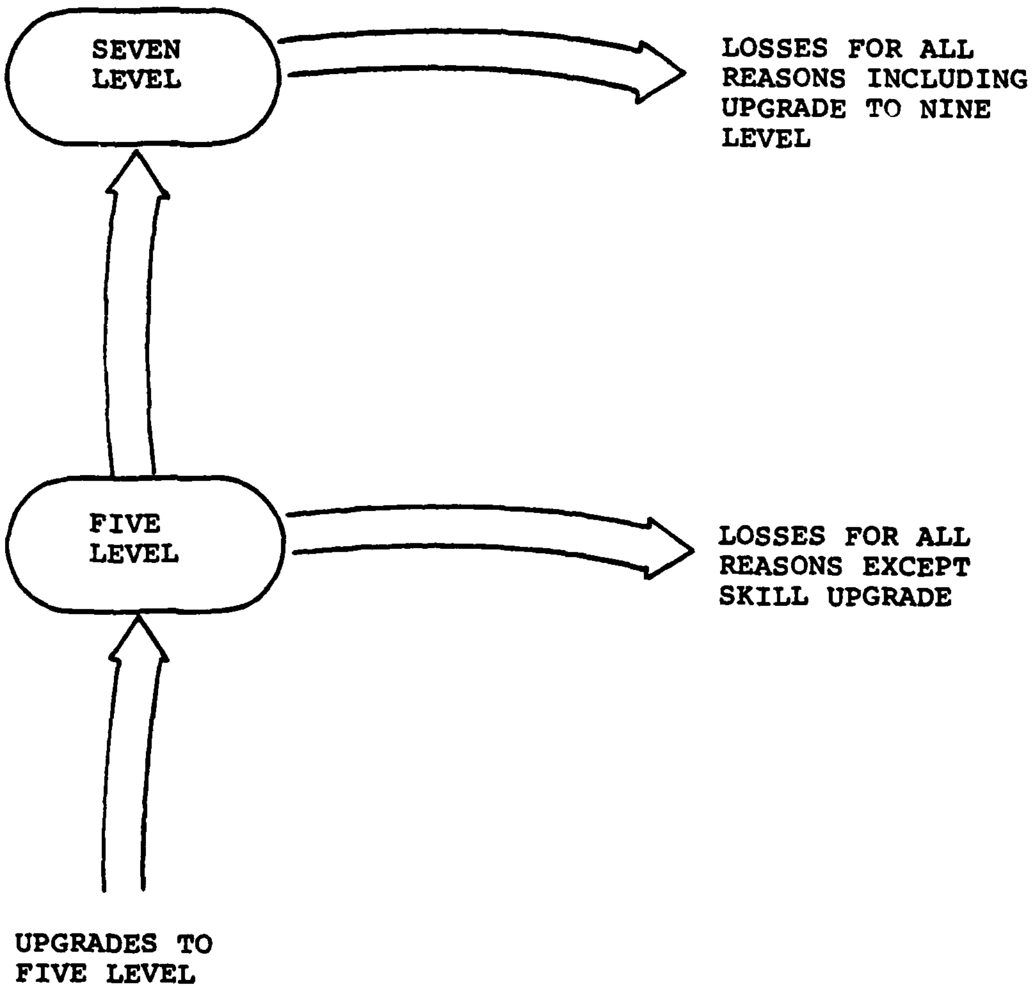
SKILL UPGRADE RATES

AFSC/ Weighting Factor	Average # of Upgrades Per Month	Five Level Upgrades Minus Seven Level	Frac- tional Loss Rate
30450/1358	32.48	23.64	.0174
30454/2196	45.64	31.36	.0143
30455/ 363	9.16	6.60	.0182
30456/ 310	9.40	4.88	.0157
30470/ 626	8.84	--	.0141
30474/1032	14.28	--	.0138
30475/ 135	2.56	--	.0189
30476/ 167	4.52	--	.0271
Overall Five Level Rate: .015		Overall Seven Level Rate: .015	

upgrade rate. Again, this is based on the argument given in Cahpter III that, in the long run, upgrades must equal losses. Upgrades into the seven level are set to compensate for these manpower losses.

The loss rate for five level personnel is similarly computed. In this case, five level personnel either upgrade to the seven level, remain five levels, or leave the system as losses. Therefore, in the long run, upgrades into the five level balance losses and upgrades to the seven level.

The model uses the net of the five and seven level upgrades (personnel/month) to approximate the five level loss rate from the system. It should be noted that upgrades from the five to the seven level are not net losses to the system. Figure 27 schematically depicts the relationship of upgrade and loss rates for five and seven levels.



UPGRADES TO FIVE LEVEL MUST BALANCE OUT THE FIVE LEVEL LOSSES AND UPGRADES TO THE SEVEN LEVEL.

UPGRADES TO SEVEN LEVEL MUST BALANCE OUT SEVEN LEVEL LOSSES.

Figure 27

RELATIIONSHIP OF UPGRADE AND LOSS RATES
FOR FIVE AND SEVEN LEVELS

```
      PROGRAM DATPRO
      INTEGER ACSTA,ASTAT,DASD,DASM,DASY,DERD,DERM,DERY,MU,
     +        ODSDD,ODSDM,ODSDY,SKI,SKILL,TRCTI,UPGRDA,
     +        YU,TOURLA,TOURLR,DERAR,DERAA,ODSD,ACCOM,
     +        EADY,EADM,EADD,EAD
      CHARACTER TRCTC*1,LIST*18
      PARAMETER (LIST='ABCDEFGJKLMPSTWXYZ')
      DO 50 I=1,9578,1
      READ (14,100) SKI,EADY,EADM,EADD,YU,MU,ASTAT,TRCTC,
     +ACCOM,DASY,DASM,DASD,DERY,DERM,DERD,ODSDY,ODSDM,ODSDD
      SKILL=(SKI-3)/2
      IF((SKILL.EQ.1).OR.(SKILL.EQ.2)) THEN
         UPGRDA=JULIAN(YU,MU,01)
         ODSD=JULIAN(ODSDY,ODSDM,ODSDD)
         TRCTI=INDEX(LIST,TRCTC)
         EAD=JULIAN(EADY,EADM,EADD)
         IF (EAD.EQ.ODSD) THEN
            ODSD=0
         END IF
         IF (ASTAT.EQ.2) THEN
            IF((ACCOM.EQ.0).OR.(ACCOM.EQ.2).OR.(ACCOM.EQ.9))THEN
               ACSTA=1
            ELSE
               ACSTA=2
            END IF
            IF ((TRCTI.LE.12).AND.(TRCTI.GE.10)) THEN
               TOURLA=0
               DERAR=JULIAN(DERY,DERM,DERD)
               TOURLR=DERAR-JULIAN(DASY,DASM,DASD)
               DERAA=0
            ELSE IF (TRCTI.GE.16) THEN
               TOURLR=0
               DERAA=0
               DERAR=0
               TOURLA=0
            ELSE
               DERAR=0
               TOURLR=0
               DERAA=JULIAN(DERY,DERM,DERD)
               TOURLA=DERAA-JULIAN(DASY,DASM,DASD)
            END IF
         ELSE
            TOURLA=0
            DERAA=0
            TOURLR=0
            DERAR=0
         END IF
      WRITE (16,200) UPGRDA,ODSD,TOURLA,TOURLR,DERAA,DERAR,SKILL,
     +TRCTC,TRCTI
      END IF
   50 CONTINUE
C
```

```
C       FORMAT FOR READ STATEMENT
100     FORMAT(4X,I1,2X,3I2,8X,2I2,I1,1X,A1,I1,3X,9I2)
C
C       FORMAT FOR WRITE STATEMENT
200     FORMAT (4X,6(I5,3X),I1,3X,A1,3X,I2)
        END
C
C
        FUNCTION JULIAN(Y,M,D)
        INTEGER Y,M,D,SUM,MONTH(12)
        DATA(MONTH(I),I=1,12)/31,28,31,30,31,30,2*31,30,31,30,31/
C
C       CHECK THE YEAR
        IF((Y.GE.88).OR.(Y.LE.62)) THEN
           JULIAN=0
           GO TO 5
        END IF
C
C       CHECK THE MONTH
        IF((M.GT.12).OR.(M.LT.1)) THEN
           JULIAN=0
           GO TO 5
        END IF
C
C       CHECK THE DAY
        IF((D.GT.31).OR.(D.LT.1)) THEN
           JULIAN=0
           GO TO 5
        END IF
        SUM=D
        DO 110 I=1,M+1
           SUM=SUM + MONTH(I)
110     CONTINUE
        JULIAN=((Y+62)*365.25 + SUM)/30.167
5       CONTINUE
        END
```

APPENDIX B

TABULATED RESEARCH RESULTS

TABLE 13

ACCOMPANIED ASSIGNMENTS
AFSC: 30450
AVERAGED PROBABILITIES

THROUGHPUT: 25 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	3.486	3.382	3.310

THROUGHPUT: 53.3 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	3.506*	3.404	3.337
1500	3.438	3.273	3.167
2000	3.348	3.134	2.994
2500	3.254	2.987	2.818

THROUGHPUT: 80 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	3.566	3.482	3.412
1500	3.492	3.328	3.214
2000	3.401	3.166	3.021
2500	3.262	2.995	2.824

$APROB_b(A,S)$ = Baseline Rate: 3.510
All units in percent/month
This data was used to test Ho: $APROB_b(,A) = APROB_{at}(A,S)$
*Indicates the difference in means was not statistically significant at p = <.05

TABLE 14

ACCOMPANIED ASSIGNMENTS
AFSC: 30454
AVERAGED PROBABILITIES

THROUGHPUT: 25 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	1.915	1.928	1.937

THROUGHPUT: 53.3 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	1.914	1.929	1.939
1500	2.013	2.040	2.053
2000	2.120	2.158	2.176
2500	2.245	2.291	2.307

THROUGHPUT: 80 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	1.298	1.944	1.953
1500	2.024	2.055	2.072
2000	2.120	2.187	2.212
2500	2.259	2.317	2.348

$APROB_b(A,S)$ = Baseline Rate: 1.744
All units in percent/month
This data was used to test Ho: $APROB_b(A,S) = APROB_{at}(A,S)$
Ho was rejected in all cases

TABLE 15

ACCOMPANIED ASSIGNMENTS
AFSC: 30455
AVERAGED PROBABILITIES

THROUGHPUT: 25 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.861	.880	.890

THROUGHPUT: 53.3 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.864	.875	.889
1500	.910	.943	.962
2000	.964	1.015	1.043
2500	1.041	1.098	1.164

THROUGHPUT: 80 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.865	.884	.901
1500	.909	.936	.959
2000	.972	1.025	1.057
2500	1.052	1.126	1.180

$APROB_b(A,S)$ = Baseline Rate: .768
All units in percent/month
This data was used to test Ho: $APROB_b(A,S) = APROB_{at}(A,S)$
Ho was rejected in all cases

TABLE 16

ACCOMPANIED ASSIGNMENTS
AFSC: 30456
AVERAGED PROBABILITIES

THROUGHPUT: 25 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	1.901	1.918	1.922

THROUGHPUT: 53.3 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	1.901	1.916	1.920
1500	1.988	2.014	2.030
2000	2.080	2.117	2.130
2500	2.223	2.266	2.276

THROUGHPUT: 80 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	1.904	1.931	1.948
1500	2.001	2.014	2.045
2000	2.104	2.164	2.175
2500	2.232	2.290	2.300

$APROB_b(A,S)$ = Baseline Rate: 1.745
All units in percent/month
This data was used to test Ho: $APROB_b(A,S) = APROB_{at}(A,S)$
Ho was rejected in all cases

TABLE 17

ACCOMPANIED ASSIGNMENTS
AFSC: 30470
AVERAGED PROBABILITIES

THROUGHPUT: 25 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	1.752	1.913	2.021

THROUGHPUT: 53.3 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	1.844	2.012	2.125
1500	1.428	1.646	1.793
2000	1.153	1.352	1.515
2500	.914	1.137	1.305

THROUGHPUT: 80 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	1.872	2.056	2.174
1500	1.428	1.682	1.847
2000	1.072	1.368	1.575
2500	.867	1.132	1.332

$APROB_b(A,S)$ = Baseline Rate: 2.747
All units in percent/month
This data was used to test Ho: $APROB_b(A,S) = APROB_{at}(A,S)$
Ho was rejected in all cases

TABLE 18

ACCOMPANIED ASSIGNMENTS
AFSC: 30474
AVERAGED PROBABILITIES

THROUGHPUT: 25 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	1.231	1.242*	1.243*

THROUGHPUT: 53.3 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	1.294	1.283	1.278
1500	1.252	1.263	1.259
2000	1.166	1.189	1.210
2500	1.053	1.106	1.144

THROUGHPUT: 80 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	1.317	1.300	1.290
1500	1.335	1.312	1.297
2000	1.304	1.300	1.289
2500	1.234	1.237	1.250

$APROB_b(A,S)$ = Baseline Rate: 1.243
All units in percent/month
This data was used to test Ho: $APROB_b(A,S) = APROB_{at}(A,S)$
*Indicates the difference in means was not statistically significant at p =<.05

TABLE 19

ACCOMPANIED ASSIGNMENTS
AFSC: 30475
AVERAGED PROBABILITIES

THROUGHPUT: 25 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.682	.657	.643

THROUGHPUT: 53.3 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.699	.673	.655
1500	.765	.713	.688
2000	.832	.764	.723
2500	.932	.807	.763

THROUGHPUT: 80 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.703	.672	.653
1500	.791	.729	.697
2000	.896	.798	.746
2500	1.101	.887	.803

$APROB_b(A,S)$ = Baseline Rate: .577
All units in percent/month
This data was used to test Ho: $APROB_b(A,S) = APROB_{at}(A,S)$
Ho was rejected in all cases

TABLE 20

ACCOMPANIED ASSIGNMENTS
AFSC: 30476
AVERAGED PROBABILITIES

THROUGHPUT: 25 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	1.228*	1.240*	1.236*

THROUGHPUT: 53.3 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	1.288	1.279	1.275
1500	1.242*	1.249*	1.252
2000	1.152	1.183	1.203
2500	1.055	1.098	1.129

THROUGHPUT: 80 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	1.311	1.300	1.284
1500	1.324	1.298	1.290
2000	1.290	1.277	1.280
2500	1.258	1.229*	1.241*

$APROB_b(A,S)$ = Baseline Rate: 1.241
All units in percent/month
This data was used to test Ho: $APROB_b(A,S) = APROB_{at}(A,S)$
*Indicates the difference in means was not statistically significant at p =<.05

TABLE 21

ACCOMPANIED ASSIGNMENTS
AFSC: CONSOLIDATED--FIVE LEVEL
AVERAGED PROBABILITIES

THROUGHPUT: 25 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	2.195	2.185	2.178

THROUGHPUT: 53.3 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	2.195	2.185	2.179
1500	2.254	2.241	2.229
2000	2.314	2.298	2.279
2500	2.387	2.363	2.336

THROUGHPUT: 80 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	2.213	2.208	2.202
1500	2.268	2.255	2.245
2000	2.355	2.322	2.305
2500	2.396	2.380	2.360

Baseline Rate: N/A
All units in percent/month

TABLE 22

ACCOMPANIED ASSIGNMENTS
AFSC: CONSOLIDATED--SEVEN LEVEL
AVERAGED PROBABILITIES

THROUGHPUT: 25 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	1.318	1.361	1.384

THROUGHPUT: 53.3 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	1.374	1.403	1.424
1500	1.254	1.311	1.344
2000	1.131	1.197	1.249
2500	1.000	1.089	1.156

THROUGHPUT: 80 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	1.392	1.420	1.439
1500	1.308	1.348	1.375
2000	1.204	1.269	1.312
2500	1.113	1.176	1.231

Baseline Rate: N/A
All units in percent/month

TABLE 23

REMOTE ASSIGNMENTS
AFSC: 30450
AVERAGED PROBABILITIES

THROUGHPUT: 25 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	1.333*	1.301	1.283

THROUGHPUT: 53.3 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	1.345*	1.313	1.300
1500	1.314	1.269	1.238
2000	1.287	1.217	1.172
2500	1.253	1.165	1.105

THROUGHPUT: 80 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	1.375	1.346*	1.337*
1500	1.342*	1.297	1.266
2000	1.315	1.253	1.204
2500	1.262	1.180	1.232

$APROB_b(A,S)$ = Baseline Rate: 1.335
All units in percent/month
This data was used to test Ho: $APROB_b(A,S) = APROB_{at}(A,S)$
*Indicates the difference in means was not statistically significant at p =<.05

TABLE 24

REMOTE ASSIGNMENTS
AFSC: 30454
AVERAGED PROBABILITIES

THROUGHPUT: 25 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.165	.170	.172

THROUGHPUT: 53.3 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.166	.170	.174
1500	.179	.187	.192
2000	.194	.205	.213
2500	.211	.228	.240

THROUGHPUT: 80 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.174	.172	.176
1500	.180	.189	.195
2000	.196	.210	.219
2500	.214	.233	.248

$APROB_b(A,S)$ = Baseline Rate: .144
All units in percent/month
This data was used to test Ho: $APROB_b(A,S) = APROB_{at}(A,S)$
Ho was rejected in all cases

TABLE 25

REMOTE ASSIGNMENTS
AFSC: 30456
AVERAGED PROBABILITIES

THROUGHPUT: 25 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	1.002	1.007	1.006

THROUGHPUT: 53.3 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	1.004	1.007	1.006
1500	1.027	1.030	1.031
2000	1.049	1.049	1.041
2500	1.088	1.073	1.052

THROUGHPUT: 80 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	1.003	1.012	1.019
1500	1.037	1.034	1.043
2000	1.065	1.076	1.068
2500	1.096	1.088	1.067

$APROB_b(A,S)$ = Baseline Rate: .946
All units in percent/month
This data was used to test Ho: $APROB_b(A,S) = APROB_{at}(A,S)$
Ho was rejected in all cases

TABLE 26

REMOTE ASSIGNMENTS
AFSC: 30470
AVERAGED PROBABILITIES

THROUGHPUT: 25 PERSONNEL/MONTH

TARGET MANPWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.801	.847	.881

THROUGHPUT: 53.3 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.831	.869	.903
1500	.683	.869	.903
2000	.577	.663	.726
2500	.468	.592	.654

THROUGHPUT: 80 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.840	.901	.934
1500	.704	.901	.934
2000	.544	.663	.737
2500	.402	.559	.560

$APROB_b(A,S)$ = Baseline Rate: 1.061
All units in percent/month
This data was used to test Ho: $APROB_b(A,S) = APROB_{at}(A,S)$
Ho was rejected in all cases

TABLE 27

REMOTE ASSIGNMENTS
AFSC: 30474
AVERAGED PROBABILITIES

THROUGHPUT: 25 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.132	.125	.120

THROUGHPUT: 53.3 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.136	.128	.122
1500	.163	.143	.134
2000	.190	.161	.147
2500	.233	.182	.160

THROUGHPUT: 80 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.138	.128	.121
1500	.169	.148	.136
2000	.207	.172	.153
2500	.277	.201	.172

$APROB_b(A,S)$ = Baseline Rate: .102
All units in percent/month
This data was used to test Ho: $APROB_b(A,S) = APROB_{at}(A,S)$
Ho was rejected in all cases

TABLE 28

REMOTE ASSIGNMENTS
AFSC: 30475
AVERAGED PROBABILITIES

THROUGHPUT: 25 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.088	.083	.079

THROUGHPUT: 53.3 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.089	.083	.080
1500	.107	.095	.089
2000	.130	.110	.099
2500	.175	.129	.112

THROUGHPUT: 80 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.089	.083	.080
1500	.109	.096	.089
2000	.140	.111	.100
2500	.188	.136	.115

$APROB_b(A,S)$ = Baseline Rate: .067
All units in percent/month
This data was used to test Ho: $APROB_b(A,S) = APROB_{at}(A,S)$
Ho was rejected in all cases

TABLE 29

REMOTE ASSIGNMENTS
AFSC: 30476
AVERAGED PROBABILITIES

THROUGHPUT: 25 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.682*	.688	.687*

THROUGHPUT: 53.3 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.693	.690	.693
1500	.656	.674	.684
2000	.589	.639	.664
2500	.486	.595	.627

THROUGHPUT: 80 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.697	.698	.694
1500	.683	.686	.689
2000	.610	.653	.676
2500	.457	.592	.643

$APROB_b(A,S)$ = Baseline Rate: .681
All units in percent/month
This data was used to test Ho: $APROB_b(A,S) = APROB_{at}(A,S)$
*Indicates the difference in means was not statistically significant at $p \leq .05$

TABLE 30

REMOTE ASSIGNMENTS
AFSC: CONSOLIDATED--FIVE LEVEL
AVERAGED PROBABILITIES

THROUGHPUT: 25 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.493	.492	.491

THROUGHPUT: 53.3 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.494	.485	.492
1500	.501	.500	.499
2000	.512	.509	.506
2500	.523	.519	.514

THROUGHPUT: 80 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.499	.497	.498
1500	.506	.504	.503
2000	.517	.517	.514
2500	.525	.524	.522

Baseline Rate: N/A
All units in percent/month

TABLE 31

REMOTE ASSIGNMENTS
AFSC: CONSOLIDATED--SEVEN LEVEL
AVERAGED PROBABILITIES

THROUGHPUT: 25 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.346	.351	.353

THROUGHPUT: 53.3 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.349	.350	.353
1500	.336	.343	.346
2000	.328	.335	.341
2500	.320	.329	.333

THROUGHPUT: 80 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	.350	.355	.357
1500	.341	.343	.346
2000	.326	.336	.341
2500	.321	.329	.336

Baseline Rate: N/A
All units in percent/month

TABLE 32

AVERAGE UTILIZATION
OF THE TECH SCHOOL

THROUGHPUT: 25 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	60.4	60.3	60.3

THROUGHPUT: 53.3 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	60.0	59.9	59.9
1500	86.2	86.1	86.3
2000	113.1	113.4	113.4
2500	141.2	141.5	140.7

THROUGHPUT: 80 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	64.4	64.5	64.6
1500	91.0	90.2	90.2
2000	111.0	117.9	117.9
2500	141.7	142.3	143.0

Units are number of personnel in training

TABLE 33

TIME REQUIRED TO BUILD
CONSOLIDATED AFSC

THROUGHPUT: 25 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	59.4	59.4	59.4

THROUGHPUT: 53.3 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	26.5	26.5	26.5
1500	41.5	41.5	41.5
2000	60.7	60.8	60.8
2500	88.0	88.3	88.6

THROUGHPUT: 80 PERSONNEL/MONTH

TARGET MANPOWER LEVEL	PROPORTION OF FIVE TO SEVEN LEVELS		
	50/50	60/40	67/33
1000	16.75	16.75	16.75
1500	24.35	24.35	24.35
2000	32.75	32.75	32.75
2500	43.30	43.30	43.20

Units in months

TABLE 34

THREE-WAY ANOVA FOR ACCOMPANIED
ASSIGNMENT AVERAGED
PROBABILITY

AFSC	EFFECT						
	A	B	C	AxB	AxC	BxC	AxBxC
30450	S	S	S	S	S	.332	S
30454	S	S	S	S	.055	S	.066
30455	S	S	S	S	S	.511	.746
30456	S	S	S	S	S	.050	.557
30470	S	S	S	S	S	S	S
30474	S	S	S	S	S	S	S
30475	S	S	S	S	S	S	S
30476	S	.156	S	S	S	S	S
C5	S	S	S	S	.015	.805	.281
C7	S	S	S	.121	.558	.287	.352

Anova for assignment probability by A, B, C

Factor A: Total manpower in consolidated AFSC
Factor B: Proportion of five to seven levels
Factor C: Training school throughput

C5 = Consolidated AFSC five level
C7 = Consolidated AFSC seven level

Fixed effects model
S = Significant at p<.01

TABLE 35

THREE-WAY ANOVA FOR REMOTE ASSIGNMENT AVERAGED PROBABILITY

AFSC	EFFECT						
	A	B	C	AxB	AxC	BxC	AxBxC
30450	S	S	S	S	.030	.792	.569
30454	S	S	S	S	.187	.585	.044
30456	S	S	S	S	S	.025	.498
30470	S	S	.749	S	S	S	S
30474	S	S	S	S	S	S	S
30475	S	S	S	S	S	S	.146
30476	S	S	S	S	S	.586	S
C5	S	S	S	.038	.263	.239	.629
C7	S	S	S	S	.156	.934	.112

Anova for assignment probability by A, B, C

Factor A: Total manpower in consolidated AFSC
Factor B: Proportion of five to seven levels
Factor C: Training school throughput

C5 = Consolidated AFSC five level
C7 = Consolidated AFSC seven level

Fixed effects model
S = Significant at $p<.01$

TABLE 36

KOLMOGOROV-SMIRNOV TESTS OF NORMALITY
ON ASSIGNMENT PROBABILITIES

VARIABLE	TEST RESULT			
	BASELINE PERIOD		WITH TREATMENT	
	REMOTE	ACCOMPANIED	REMOTE	ACCOMPANIED
30450	.852	.988	.997	.825
30454	NT	.813	NT	.819
30455	NA	.941	NA	.794
30456	.061	.561	.936	.994
30470	.968	.777	.992	.857
30474	.819	.444	.613	.988
30475	.128	.985	NT	.988
30476	.334	.738	.030*	.076
C5	NA	NA	.508	.963
C7	NA	NA	.825	.999

Tests the hypothesis Ho:
Result reported is 2-tailed p based on K-S Z value
*Reject Ho

NA = Not applicable
NT = Not tested

APPENDIX C

TECHNICAL DESCRIPTION OF THE MODEL

Introduction

The computer model used to simulate the AFSC consolidation was written in Simulation Language for Alternative Modeling (SLAM). This entailed composing a set of SLAM input statements and a series of FORTRAN subroutines. The SLAM statements and FORTRAN subroutines are imbedded in and interact through the SLAM executive program.

This appendix will explain the operation of the model in terms of the individual pieces and will then illustrate the interaction of the parts. The general topics to be covered are the relation to the SLAM executive and the operation of the user-written programs.

Relation to the SLAM Executive

Pritsker (21:402-430) provides a complete description and examples of the operation of SLAM models which employ network, discrete, and continuous concepts. This discussion will be confined to the specifics of the model used in this research. The best starting point is the overall block diagram shown in Figure 28, adapted from Pritsker (21:349).

The main program, labeled "MAIN", does little but call the SLAM executive. The SLAM executive retains control of the simulation till all activity is completed. Program MAIN simply defines input and output devices and files, as well as allocating sufficient storage to the

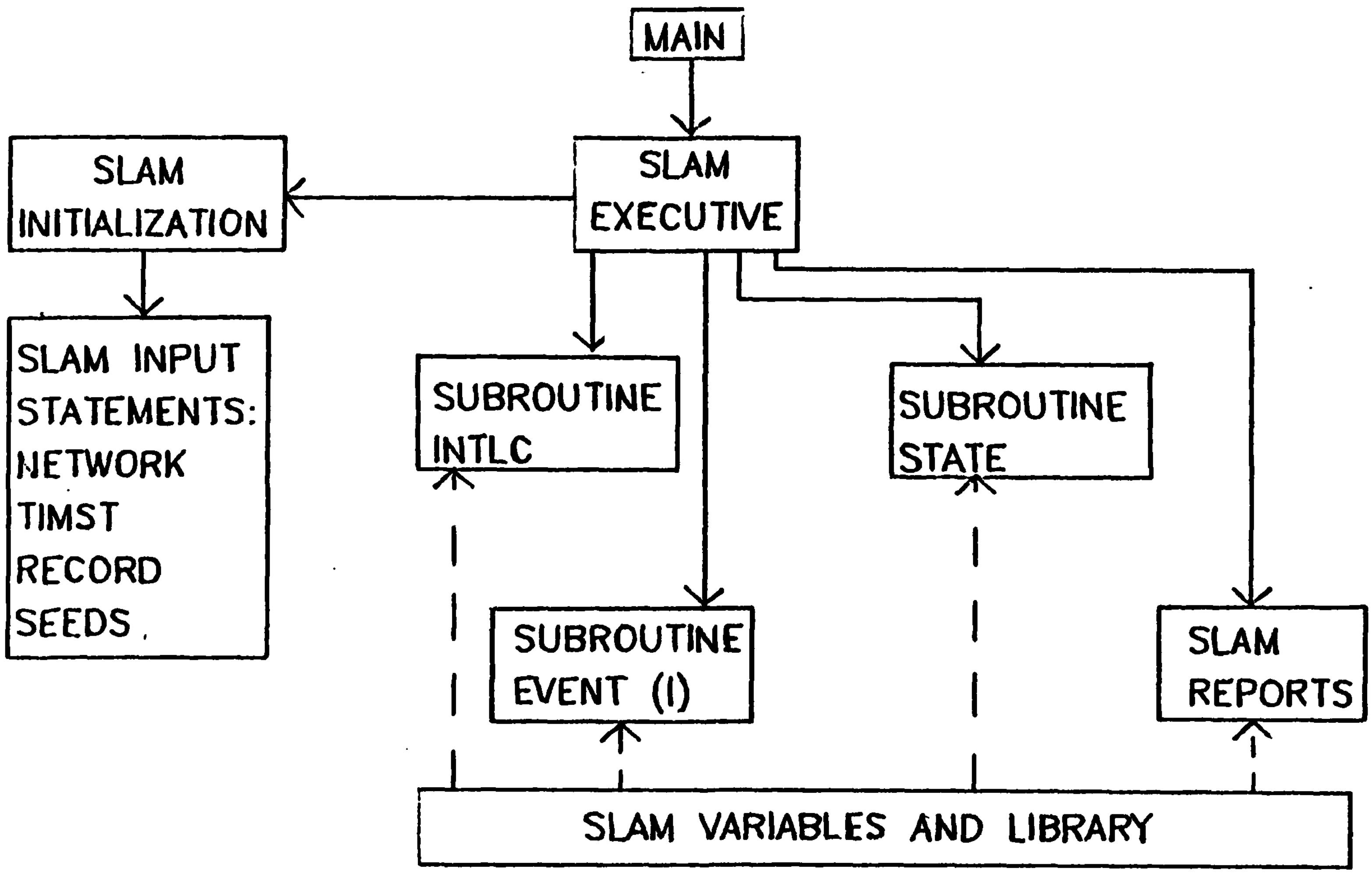


Figure 28

Relationship to the SLAM Executive

SLAM executive. The storage allocation is a function of the requirements of the user-written routines. The primary determinant of storage is the number of variables whose values will be recorded over time.

With control of the simulation in the SLAM executive, the first subroutine called is INTLC which is an initialization routine. Subroutine INTLC is used to define the starting condition of the model as well as the manpower targets. After being called initially, subroutine INTLC is never used again.

SLAM initialization consists of reading and interpreting the SLAM input statements which are contained in the portion of the model called "NETWORK". NETWORK defines the statistics collection requirements, data recording requirements and random number streams to be used. It also specifies the SLAM network which controls the overall course of the simulation and, in particular, the operation of the technical school which trains personnel into the consolidated AFSC.

NETWORK, subroutine STATE, and subroutine EVENT (I) are all called by the SLAM executive according to the events and conditions which occur in the simulation. Simply put, the SLAM executive controls the advance of time in the simulation.

In this case, the maximum time advance corresponds to one simulated month. Should no event occur in the intervening time, the simulation will continue to advance in units of one month. However, in all likelihood there will be events which occur within the simulated one month timeframe.

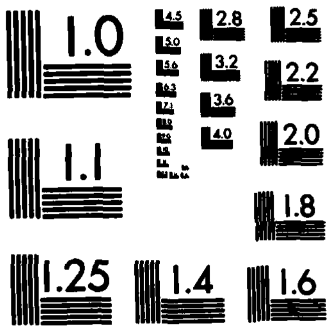
These events are caused by NETWORK. The executive schedules these events to occur, and when they do, the executive insures that all of the model's variables are evaluated and updated at that time. In practice this involves a pass through subroutine STATE and through the coding in subroutine EVENT (I) which corresponds to the event which occurred.

When the stopping conditions of the simulation are met, or when the maximum time allocated is attained (120 time units), the executive produces the SLAM Reports which give the results of the model run. In the case of this simulation, multiple runs of the model are called for. Therefore, the executive repeats the process described above before returning control to program MAIN to end the simulation.

The model's user variables are equivalenced to individual SLAM variables to simplify statistics collection and control. In effect, SLAM is set up to monitor and record its internal variables with simple user requests. Since there were ninety six variables of interest, the most efficient strategy was to equivalence them to some of the SLAM variables available for just

AD-A122 848   A DYNAMIC COMPUTER MODEL TO EXAMINE SELECTED EFFECTS OF   3/3
304XX CAREER FIEL..(U) AIR FORCE INST OF TECH
WRIGHT-PATTERSON AFB OH SCHOOL OF SYTT..
UNCLASSIFIED   J R LITKO ET AL. SEP 82 AFIT-LSSR-66-82   F/G 9/2   NL

END
FILMED
DTIC


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
6.3

that purpose.

Subroutine INTLC

This subroutine specifies the number and distribution of personnel in the model at the start of the simulation. This amounts to equating the number of personnel in CONUS, accompanied, and overseas tours to their authorized strength. This data is derived from AFMPC documents.

Subroutine INTLC is also used to zero cut the number of personnel in the consolidated AFSC and the technical school as well as requirements for personnel in the consolidated AFSC. This permits the model to be run in a validation mode which corresponds to existing conditions. That is, the validation mode simulates overseas rotation in the absence of a consolidated AFSC. The purpose of this precaution is to be able to compare the model to current assignment rates without structurally altering the model.

Network

NETWORK has two principal parts. First, there are the statements which describe statistics collection and data recording. Second, there are the network type statements which model the technical school operation. These will be described in turn. A complete listing of NETWORK for a typical model run is at the end of this

Appendix.

Statistics/Data Collection

TIMST statements are used to cause time weighted average statistics to be recorded on selected SLAM variables. In this case the variables of interest are the assignment rates and assignment probabilities. The TIMST statement assumes that the monitored variable has a value defined over a period of time. This application is consistent with the model's world view that assignment rates can be looked at as flows evenly distributed over time.

The output of the TIMST statement or process is a time-weighted average and standard deviation of the variable monitored. The monitoring was facilitated by equivalencing the assignment rate and probability variables to global SLAM variables.

The RECORD statement and its counterparts, the VAR statements, simply cause the values of variables to be recorded at specified times. In this application, variable values in the transitory period were recorded and plotted by using the RECORD and VAR statements.

Again, this procedure is simplified by equivalencing model variables with SLAM variables. One VAR statement is used to cause recording of a single dependent variable at each value of the independent variable. In this case, the independent variable is time which is so specified on the RECORD statement. The output then is a plot of assignment rates or probabilities versus time.

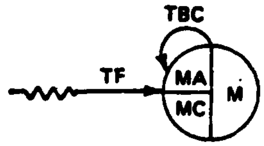
A final comment on statistics and data collection regards the SEEDS statements. These statements change the values of the seeds to random number streams used in the model. Their purpose is to insure that the same stream of random numbers is used for each set of parameters investigated. The SEEDS statements also insure that each individual run starts with a new random number stream that can be replicated.

Network Type Statements

Figures 29 and 30 are general diagrams explaining the meanings of the SLAM symbols. They were taken from Pritsker (21:539-551). Figure 31 is a diagram of the model's SLAM network using the SLAM symbology. This network controls the overall operation of the model run. It can be thought of as a nodal network where activity occurs only between nodes and events occur at nodes.

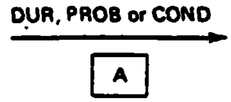
The CREATE node begins network activity by starting an entity down activity number one. As shown in Figure the duration of activity number one is five months. The duration of activity one is the length of time before starting the flow into the consolidated AFSC. In validation runs, this activity duration was extended to just over fifty months to allow a longer statistics collection

Node Type: CREATE **Symbol:**



Function: The CREATE node is used to generate entities within the network. The node is released initially at time TF and thereafter according to the specified time between creations TBC up to a maximum of MC releases. At each release, a maximum of M emanating activities are initiated. The time of creation is stored in ATRIB(MA) of the created entity.

Activity Type: REGULAR **Symbol:**



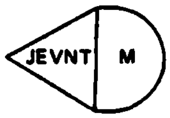
where

N is the number of parallel servers if the activity represents a set of identical servers;

A is an activity number (an integer);

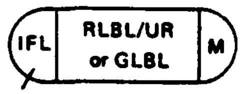
DUR is the duration specified for the activity;

Node Type: EVENT **Symbol:**



Function: The EVENT node causes subroutine EVENT to be called with event code JEVNT at each entity arrival. This allows the user to model functions for which a standard node is not provided. A maximum of M emanating activities are initiated.

Node Type: AWAIT **Symbol:**



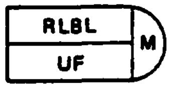
Function: The AWAIT node operates in two modes. In the resource mode, the AWAIT node delays an entity in file IFL until UR units of resource RLBL are available. The entity then seizes the UR units of RLBL. In the gate mode, the AWAIT node releases the entity if the gate status is open and delays the entity in file IFL if the gate status is closed. At each release of the node a maximum of M activities are initiated.

FIGURE 29

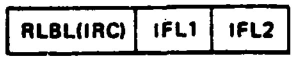
SLAM Symbology

Block Type: GATE **Symbol:** 

Function: A GATE block defines a gate by its label GLBL. The initial status of the gate is set through an OPEN or CLOSE prescription. The file numbers, IFLs, reference the AWAIT nodes where entities waiting for the gate to open are queued.

Node Type: FREE **Symbol:** 

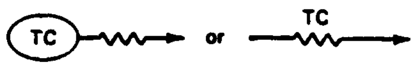
Function: The FREE node releases UF units of resource RLBL. The resource is made available to waiting entities according to the order of the wait files specified in the RESOURCE statement. A maximum of M emanating activities are initiated.

Block Type: RESOURCE **Symbol:** 

Function: A RESOURCE block defines a resource by its label RLBL and its initial capacity or availability IRC. The file numbers, IFLs, associated with AWAIT and PREEMPT nodes are where entities requesting units of the resource are queued. The IFLs are listed in the order in which it is desired to allocate the units of the resource when they are made available.

Node Type: GOON **Symbol:** 

Function: The GOON node provides a continuation node where every entering entity passes directly through the node. It is a special case of the ACCUMULATE node with FR and SR set equal to one. A maximum of M emanating activities are initiated.

Node Type: TERMINATE **Symbol:** 

Function: The TERMINATE node is used to destroy entities and/or terminate the simulation. All incoming entities to a TERMINATE node are destroyed. The arrival of the TCth entity causes a simulation run to be terminated.

FIGURE 30

SLAM Symbology Continued

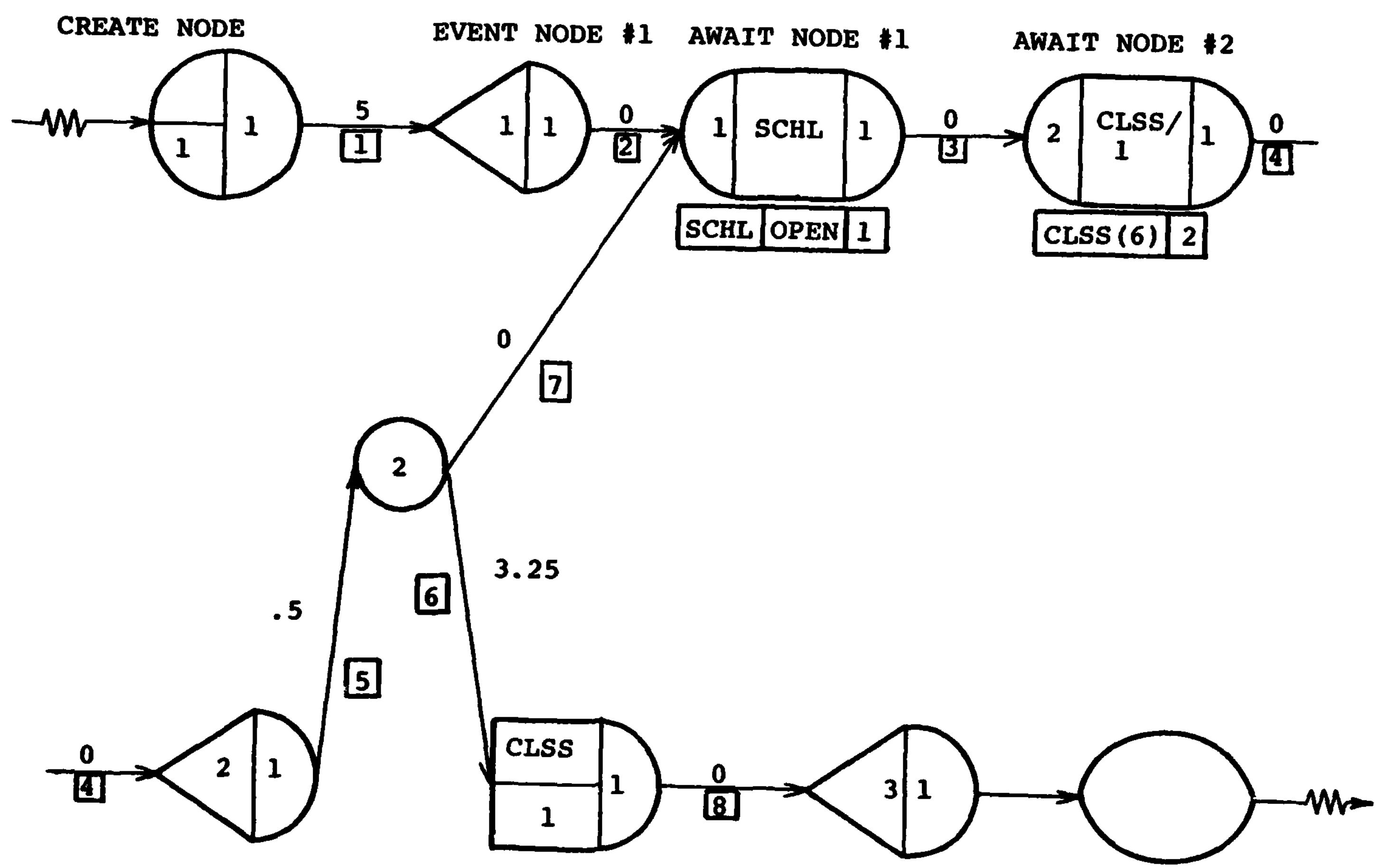


Figure 31

SLAM Diagram of Network

interval.

When the entity reaches EVENT node number one, the flow of personnel into the consolidated AFSC begins. This EVENT node causes subroutine EVENT (1) to be called to define the parameters of the consolidated AFSC.

The entity is passed through activity number two without delay to AWAIT node number one. There, the entity must wait until the gate to the technical school is opened. Initially, that gate is set to an open status and, therefore, the entity passes through activity number three to AWAIT node number two.

At AWAIT node number two the entity must wait until a class is available at the technical school. The number of available classes are modeled as a finite resource. The maximum number available essentially control the throughput rate of the technical school for the model run.

Since initially all classes are available, the entity passes through activity four to EVENT node number two. This EVENT node calls subroutine EVENT (2) to enter the first class into the simulated training.

At this point the entity takes on a more concrete interpretation since it can be thought of as a class moving through the technical school. The entity carries along with it attributes that represent the number of persons from each AFSC and skill level that make up the class.

Activity number five represents the time until the next class can begin. Its purpose is to prevent all available classes from starting simultaneously. The duration of activity five is chosen with two constraints in mind. First, it is made small enough so that it does not itself limit throughput which is an experimental parameter. Second, it is made large enough to spread out the flow of personnel into the technical school.

After activity number five, the GOON node simply branches the entity in two directions. The branch back to AWAIT node number one loses the interpretation of a current class and is actually used to keep the training process cycling. It guarantees that a class will always be ready to start whenever requirements for training exist (gate open) and classes are available (resource available).

The branch from the GOON node through activity number six represents the remaining duration of the technical school, in this case 3.25 months. The FREE node marks the end of a training class and returns the resource back to the pool of available classes.

Immediately after this, EVENT node number three is triggered which calls subroutine EVENT (3). At this point personnel have graduated into the consolidated AFSC and the model's variables are adjusted to show this input.

The TERM node which follows is actually optional and merely serves to absorb the entity--in effect, a sink.

Subroutine EVENT (I)

The operation of subroutine EVENT (I) follows directly from the description of NETWORK provided above. Each of the three EVENT nodes corresponds to a portion of subroutine EVENT (I).

The first portion establishes the manpower targets in the consolidated AFSC at each skill level. These targets were varied according to the experimental design as described in Chapter III. The other function is to calculate the number of personnel that will be desired in the four original AFSCs after the consolidated AFSC is formed. This determines how many personnel will be deducted from each AFSC to form the consolidated AFSC.

The second portion of subroutine EVENT (I) selects personnel from each AFSC for entry into a class. The number selected is based on two factors: the number of personnel required at a given skill level (five or seven) and the original AFSC's size relative to the other AFSCs.

In short, it selects personnel proportionately and deducts the number selected from that AFSC's total manpower. The number selected at each AFSC and skill level are recorded as the attributes of the entity in the network segment of the model.

The third portion of subroutine EVENT (I) represents graduation. Consequently, the graduates are allocated by skill level to the consolidated AFSC.

Subroutine STATE

Four equations drive the modeling of the assignment process. These are the equations for the number of returnees from accompanied and remote tours in the consolidated and the original AFSCs. Each of these equations is of the form

$$\text{Rate} = \frac{\text{\# of personnel in particular status}}{\text{time spent in particular status}}$$

The number of personnel to be assigned to any overseas area compensates for the returnees plus any difference (either shortage or overage) caused by skill upgrades. The level equations simply tally up the net rates into and out of the level during any given time period. Normally, this is done at monthly intervals. If, however, an event occurs within a month, SLAM adjusts the size of the time increment automatically.

Losses, due to discharge, upgrade or any other reason, from the consolidated AFSC are put back into the four original AFSCs. The inputs back into the four original AFSCs are apportioned to insure that the desired number of personnel (variable DNPA) are maintained in each AFSC and skill level. Consequently, the total number of personnel in the model stays constant.

The five and seven levels of the consolidated AFSC are connected by the skill upgrade process. In the model, upgrades occur only when vacancies exist. Consequently, upgrades to the seven level just balance seven level losses.

An important feature of subroutine STATE is the manner in which it apportions assignments between the consolidated and original AFSCs and the manner it allocates the consolidated AFSC to particular overseas billets. The allocation mechanism used was made to fit the objectives stated for the AFSC consolidation.

The model calculates the percentage of total personnel in CONUS that are in the consolidated AFSC. The consolidated AFSC then receives that percentage of all overseas assignments as an assignment quota. For instance, if twenty percent of all CONUS personnel are in the consolidated AFSC, they receive twenty percent of all overseas assignments.

There are two reasons for setting an assignment quota this way. First, since personnel from the consolidated AFSC come from the four original AFSCs, they would probably have representative assignment histories and consequently average assignment vulnerability. Second, there are no assignment billets that belong uniquely to the consolidated AFSC. They fill only the billets of the original AFSCs. Therefore, an arbitrary quota must be used to calculate assignment requirements.

The model allocates the quota of consolidated AFSC personnel among the overseas billets according to the severity of imbalance for each of the AFSCs at both skill levels. Simply put, the more imbalanced AFSCs receive greater assistance from the consolidated AFSC. This reflects one stated intent of the AFSC consolidation (i.e., to address and remedy the URI problem).

The particular algorithm that allocates the personnel is designed to function across the full range of target manpower levels in the consolidated AFSC. The algorithm permits some consolidated AFSC personnel to be assigned to each of the original AFSCs overseas. Yet it directs most help to the imbalanced AFSCs. This permits a study of the tradeoffs inherent in attempting to balance the AFSCs' assignment pictures.

Subroutine STATE calls the SLAM subroutines OPEN (I) and CLOSX (I) which open or close the technical school gate within NETWORK. The technical school may still have classes in progress when CLOSX (I) is called. This simply prevents new classes from starting until requirements are large enough.

The interaction between NETWORK, EVENT (I), and STATE is thus a flow of personnel from the original AFSCs to the consolidated AFSCs. This interaction is shown in Figure 32. Feedback from STATE to NETWORK supplies the

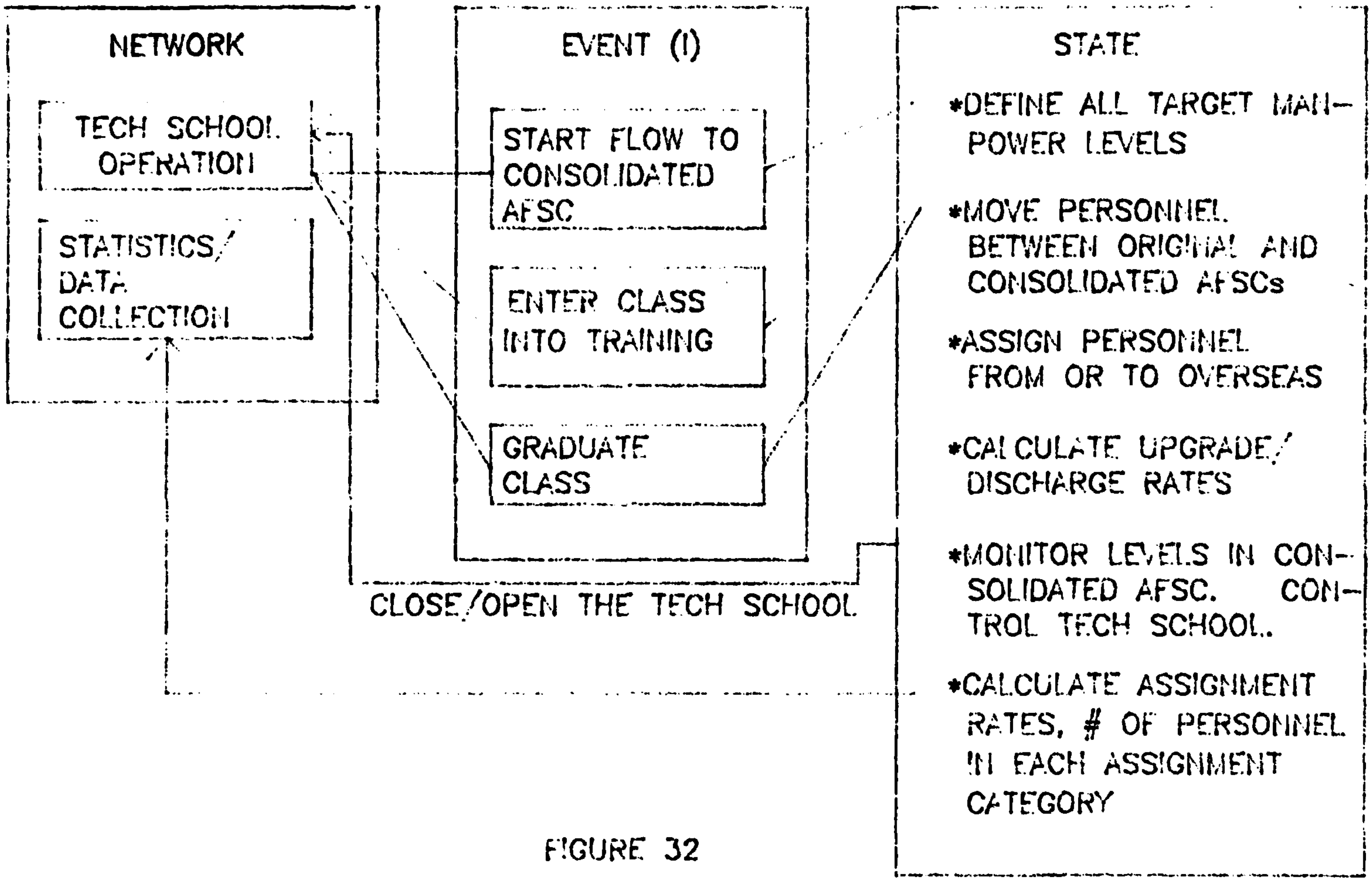


FIGURE 32

INTERACTION WITHIN THE MODEL

necessary control to keep manpower levels at targeted values.

```
      PROGRAM MAIN(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,TAPE7)
C
C
C     PROGRAM MAIN IS A FAIRLY STANDARDIZED
C     REQUIREMENT OF THE SLAM METHODOLOGY WITH
C     NO SIGNIFICANT USER CODING IN THIS CASE.
C
C
C     ---------------------------------------------------------
C                   LISTING OF VARIABLES
C     ---------------------------------------------------------
C                           RATES
C     ---------------------------------------------------------
C     ASMOS(A,S)        ASSGNMTS FROM MSTR TO OSEAS IN AFSC A
C                       SKILL S (NON-REMOTE)
C     ASMROS(A,S)       ASSGNMTS FROM MASTR TO REMOTE IN
C                       AFSC A SK S
C     ASAOS(A,S)        ASSGNMTS TO OSEAS FROM/TO AFSC A
C                       SKILL S (NON-REMOTE)
C     ASAROS(A,S)       ASSGNMTS TO REMOTE FROM OR TO
C                       AFSC A, SK S
C     REMOS(A,S)        RETURN TO MSTR FROM OSEAS (NON-REMOTE)
C     REMROS(A,S)       RETURN TO MSTR IN CONUS FROM REMOTE
C     REAOS(A,S)        RETURN TO CONUS - AFSC A SK S  (NON-
C                       REMOTE)
C     REAROS(A,S)       RETURN TO CONUS FROM REMOTE - AFSC A SK S
C     SREMOS(S)         SUM OF THE FLOWS INTO THE MASTER
C     SASMOS(S)         SUM OF THE OSEAS RATES OUT OF MASTER
C     DISCHM(S)         DISCHARGE LOSSES FROM MASTER, SK S
C     UPOM(S)           SK UPGRADE OUT OF MSTR  SK S
C     UPIM(S)           SK UPGRADE INTO MASTER, SK S
C
```

```
C
C     ------------------------------------------------------------
C                            LEVELS
C     ------------------------------------------------------------
C     MCON(S)               # OF MSTR STATIONED IN CONUS, SK S
C     ACON(A,S)             # IN AFSC A,SK S IN CONUS
C     AOS(A,S)              # IN AFSC A, SK S OSEAS (NON-REMOTE)
C     AROS(A,S)             # IN AFSC A, SK S ON REMOTE
C     MROS(A,S)             # IN MSTR ON REMOTE IN SLOTS OF
C                           AFSC A, SK S
C     MOS(A,S)              # IN MSTR OSEAS IN SLOTS OF AFSC A,
C                           SK S (NON-REMOTE)
C
C
C
C     ------------------------------------------------------------
C                           AUXILIARIES
C     ------------------------------------------------------------
C     PA(A,S)               TOTAL PERSONNEL IN AFSC A, SK S
C     PM(S)                 TOTAL IN MSTR AT SK S
C     SMOS(S)               SUM OF MSTR PERSONNEL OSEAS IN SLOTS
C                           OF THE VARIOUS AFSCS (NON-REMOTE)
C     SMROS(S)              SUM OF THE MSTR PERSONNEL REMOTE IN
C                           SLOTS OF THE VARIOUS AFSCS
C     STESCH                TOTAL NUMBER OF PERSONNEL IN TECH SCHOOL
C     RNMAS(S)              SHORTFALL IN MSTR AT SK S
C     TESCH(S)              # IN TECH SCHOOL AT SK S
C     TRMAS                 TOTAL SHORTFALL IN MSTR AFSC
C     IMBALA(A,S)           COMPARATIVE IMBALANCE OF THE CAREER
C                           FIELD FOR ACCOMPANIED ASSIGNMENTS
C     IMBALR(A,S)           COMPARATIVE IMBALANCE OF THE CAREER
C                           FIELD FOR REMOTE ASSIGNMENTS
C     DASMA(A,S)            DESIRED ASSIGNMENTS FROM THE MASTER
C                           AFSC TO SLOTS OF AFSC A SKILL S
C     DASMR(A,S)            SAME AS DASMA EXCEPT FOR REMOTES
C     SDASMA(S)             SUM OF DASMA(A,S) ACROSS THE FOUR
C                           ORIGINAL AFSCS
```

```
C      SDASMR(S)         SAME AS SDASMA EXCEPT FOR REMOTES
C      SHORT(A,S)        THE DIFFERENCE BETWEEN DESIRED AND
C                        ACTUAL MANNING, AFSC A, SKILL LVL S
C      RATIO(A,S)        ALLOCATES INPUTS TO THE ORIGINAL AFSCS
C      TOTSHO            SUM OF SHORT(A,S) ACROSS THE AFSCS
C                        AND SKILL LEVELS
C      TEND              ENDING TIME OF A SIMULATION RUN
C      SPA(S)            SUM OF PA OVER THE AFSCS
C      SACON(S)          SUM OF ACON OVER THE AFSCS
C      SDOS(S)           SUM DOS OVER THE AFSCS
C      SDROS(S)          SUM OF DROS OVER THE AFSCS
C      DOS(A,S)          DESIRED #PERSONNEL OSEAS AFSC A, SK S
C                        (NON-REMOTE)
C      DROS(A,S)         DESIRED #PERSONNEL OSEAS AFSC A, SK S
C                        (REMOTE)
C      TOS(A,S)          TOTAL PERSONNEL OSEAS IN SLOTS OF
C                        AFSC A, SK S(NON-REMOTE)
C      TROS(A,S)         TOTAL PERSONNEL REMOTE IN SLOTS OF
C                        AFSC A, SK S
C      ROS(A,S)          DOS-TOS
C      RROS(A,S)         DROS-TROS
C      PERCEL(S)         % OF MSTR PERSONNEL ELIGIBLE TO GO OSEAS
C      SEL(A,S)          # OF PERSONNEL SELECTED FROM AFSC A, SK S
C                        FOR MSTR AFSC
C      SSEL(S)           SEL SUMMED ACROSS THE AFSCS
C      GRAD(S)           # OF GRADUATES FROM TECH SCHOOL INTO
C                        MSTR AT SK S
C      APROB(A,S)        PROBABILITY OF OSEAS ASSGNMT FOR CONUS
C                        PERSONNEL IN AFSC A, SK S
C      MPROB(A,S)        PROBABILITY OF OSEAS ASSGNMT FOR CONUS
C                        PERSONNEL IN MASTER AFSC
C      ARPROB(A,S)       PROBABILITY OF REMOTE ASSGNMT FOR CONUS
C                        PERSONNEL IN AFSC A, SK S
C      MRPROB(S)         PROBABILITY OF REMOTE ASSGNMT FOR CONUS
C                        PERSONNEL IN MSTR AFSC
C
```

```
C      ---------------------------------------------------------
C                        PARAMETERS/CONSTANTS
C      ---------------------------------------------------------
C      AVTRL(A,S)          AVERAGE TOUR LENGTH AFSC A, SK S
C                          (NON-REMOTE)
C      AVTRLR(A,S)         AVERAGE TOUR LENGTH AFSC A, SK S (REMOTE)
C      DNMAS               DESIRED NUMBER IN MASTER AFSC
C      DNPA(A,S)           DESIRED NUMBER IN ORIGINAL AFSC AFTER
C                          MASTER REACHES TARGET MANPOWER LEVEL
C      IPA(A,S)            INITIAL NUMBER IN ORIGINAL AFSCS
C      ISPA(S)             INITIAL SUM OF IPA(A,S) ACROSS AFSCS
C
C
C
       DIMENSION NSET(5000)
       COMMON QSET(5000)
       COMMON/SCOM1/ATRIB(100),DD(100),DDL(100),DTNOW,II,MFA,MSTOP,NCLNR
      +,NCRDR,NPRNT,NNRUN,NNSET,NTAPE,SS(100),SSL(100),TNEXT,TNOW,XX(100)
       EQUIVALENCE (NSET(1),QSET(1))
       NPRNT=6
       NCRDR=5
       NTAPE=7
       NNSET=5000
       CALL SLAM
       STOP
       END
C
C
       SUBROUTINE INTLC
       REAL MCON(2),MOS(4,2),MROS(4,2),MPROB(2),MRPROB(2)
C
C
C      THIS SUBROUTINE INITIALIZES THE VALUES OF MOST
C      IMPORTANT STATE VARIABLES AND RATES.  DATA STATEMENTS
C      ARE NOT USED TO INITIALIZE ANY VARIABLES WHICH MUST
C      BE PASSED BETWEEN THIS SUBROUTINE AND SUBROUTINE STATE
C      OR EVENT.  THIS IS BECAUSE OF THE SEGMENTED STRUCTURE
C      OF SLAM.
```

```
      COMMON/SCOM1/ATRIB(100),DD(100),DDL(100),DTNOW,II,MFA,MSTOP,NCLNR
     +,NCRDR,NPRNT,NNRUN,NNSET,NTAPE,SS(100),SSL(100),TNEXT,TNOW,XX(100)
      COMMON/UCOM1/DNMAS(2),SPA(2),ISPA(2),IPA(4,2),DNPA(4,2),TEND
      DIMENSION ACON(4,2),AOS(4,2),PA(4,2),PM(2),RNMAS(2),SMOS(2),
     +SMROS(2),TESCH(2),V(4,2),W(4,2),X(4,2),Y(4,2),SASMOS(2),SREMOS(2),
     +AROS(4,2),ARPROB(4,2),APROB(4,2),U(2)
      EQUIVALENCE (SREMOS(1),XX(4)),(RNMAS(1),XX(6)),
     +(TRMAS,XX(8)),(STESCH,XX(9)),(TESCH(1),XX(10)),
     +(SASMOS(1),XX(12)),(PM(1),XX(14)),(PA(1,1),XX(16)),
     +(SMOS(1),XX(24)),(SMROS(1),XX(26)),(APROB(1,1),XX(28)),
     +(ARPROB(1,1),XX(36)),(MPROB(1),XX(44)),(MRPROB(1),XX(46))
      EQUIVALENCE (MCON(1),SS(1)),(MOS(1,1),SS(3)),(ACON(1,1),SS(11)),
     +(AOS(1,1),SS(19)),(MROS(1,1),SS(27)),(AROS(1,1),SS(35))
      DATA ((X(I,J),I=1,4),J=1,2)/1581.,2623.,349.,314.,653.,
     +1132.,154.,152./
      DATA ((V(I,J),I=1,4),J=1,2)/779.,968.,69.,109.,313.,
     +369.,27.,46./
      DATA ((W(I,J),I=1,4),J=1,2)/667.,1627.,280.,184.,295.,
     +753.,126.,98./
      DATA U/4867,2091/
      DATA ((Y(I,J),I=1,4),J=1,2)/135.,28.,0.,21.,45.,10.,1.,8./
      DO 5 J=1,2
         SREMOS(J)=0.0
         SASMOS(J)=0.0
         DNMAS(J)=0.0
         SPA(J)=U(J)
         ISPA(J)=U(J)
         MCON(J)=0.0
         RNMAS(J)=0.0
         SMOS(J)=0.0
         SMROS(J)=0.0
         TESCH(J)=0.0
         PM(J)=0.0
```

```
         DO 6 I=1,4
            MOS(I,J)=0.0
            MROS(I,J)=0.0
            AOS(I,J)=V(I,J)
            ACON(I,J)=W(I,J)
            AROS(I,J)=Y(I,J)
            DNPA(I,J)=X(I,J)
            IPA(I,J)=X(I,J)
            PA(I,J)=X(I,J)
6        CONTINUE
5     CONTINUE
      TRMAS=0.0
      TEND=0.
      XX(3)=0.0
      STESCH=0.0
      RETURN
      END
C
C
      SUBROUTINE EVENT(I)
C
C
C     EVENT PROVIDES THE CODING FOR THE DISCRETE EVENTS
C     WHICH ARE CALLED FROM THE NETWORK PORTION OF THE MODEL
C
C
      INTEGER A,S,CLSSZ
      REAL MCON(2),MOS(4,2),MPROB(2),MRPROB(2),MROS(4,2)
      COMMON/SCOM1/ATRIB(100),DD(100),DDL(100),DTNOW,II,MFA,MSTOP,NCLNR
     +,NCRDR,NPRNT,NNRUN,NNSET,NTAPE,SS(100),SSL(100),TNEXT,TNOW,XX(100)
      COMMON/UCOM1/DNMAS(2),SPA(2),ISPA(2),IPA(4,2),DNPA(4,2),TEND
      DIMENSION SEL(4,2),SSEL(2),GRAD(2),RNMAS(2),TESCH(2),
     +PA(4,2),ACON(4,2),Z(4,2),PM(2),AOS(4,2),SMOS(2),
     +SREMOS(2),SASMOS(2),SMROS(2),APROB(4,2),ARPROB(4,2),
     +AROS(4,2)
```

```
      EQUIVALENCE (SREMOS(1),XX(4)),(RNMAS(1),XX(6)),
     +(TRMAS,XX(8)),(STESCH,XX(9)),(TESCH(1),XX(10)),
     +(SASMOS(1),XX(12)),(PM(1),XX(14)),(PA(1,1),XX(16)),
     +(SMOS(1),XX(24)),(SMROS(1),XX(26)),(APROB(1,1),XX(28)),
     +(ARPROB(1,1),XX(36)),(MPROB(1),XX(44)),(MRPROB(1),XX(46))
      EQUIVALENCE (MCON(1),SS(1)),(MOS(1,1),SS(3)),(ACON(1,1),SS(11)),
     +(AOS(1,1),SS(19)),(MROS(1,1),SS(27)),(AROS(1,1),SS(35))
C
      DATA SEL,SSEL,GRAD,Z/20*0.0/
C
C
      GO TO (1,2,3),I
C     ----------------------------------------
C     TURN ON FLOW TO MSTR, ESTABLISH REQUIREMENTS
C     ----------------------------------------
C
C     CREATE TARGET VALUES OF REQUIREMENTS IN MASTER AFSC.
C     DRAWDOWN MANPOWER IN ORIGINAL AFSCS AS MANPOWER IS
C     PASSED TO MASTER AFSC.
C
C
1     DNMAS(1)=667.
      DNMAS(2)=333.
      RNMAS(1)=667.
      RNMAS(2)=333.
      TRMAS=1000.
      DO 31 A=1,4
        DO 41 S=1,2
          DNPA(A,S)=IPA(A,S)*(1-(DNMAS(S)/ISPA(S)))
41      CONTINUE
31    CONTINUE
      RETURN
C
```

```
C     --------------------------------
C     SELECT FROM EACH AFSC FOR SCHOOL
C     --------------------------------
C
C     SELECTION IS BASED ON THREE FACTORS:CLASS SIZE,
C     RNMAS(S)=REQUIREMENTS AT EACH SKILL LEVEL,PA/SPA=
C     RELATIVE STRENGTH OF ONE AFSC TO TOTAL MANPOWER.
C     THE NUMBERS OF PERSONNEL SELECTED ARE CARRIED AS
C     ATTRIBUTES OF THE NETWORK ENTITY.
C
C
2     CLSSZ=20
      DO 11 S=1,2
         IF (TRMAS.GT.20.) THEN
            SSEL(S)=CLSSZ*(RNMAS(S)/TRMAS)
         ELSE
            SSEL(S)=0.
         END IF
         TESCH(S)=TESCH(S) + SSEL(S)
         DO 21 A=1,4
            SEL(A,S)=SSEL(S)*(PA(A,S)/SPA(S))
            ATRIB((S-1)*4 + A)=SEL(A,S)
            ACON(A,S)=ACON(A,S) - SEL(A,S)
21       CONTINUE
11    CONTINUE
      RETURN
C
```

```
C     ----------------------------
C     PUT GRADUATES INTO MASTER AFSC
C     ----------------------------
C
C     READS THE ATTRIBUTES OF THE NETWORK ENTITY UPON
C     COMPLETION OF THE TECH SCHOOL.  ADDS ACROSS AFSCS
C     TO GET TOTAL BY SKILL LEVEL.
C
C
3     DO 12 S=1,2
         DO 22 A=1,4
            Z(A,S)=ATRIB((S-1)*4 + A)
22       CONTINUE
12    CONTINUE
      GRAD(2)=Z(1,2)+Z(2,2)+Z(3,2)+Z(4,2)
      GRAD(1)=20.0-GRAD(2)
      DO 32 S=1,2
         MCON(S)=MCON(S)+GRAD(S)
         TESCH(S)=TESCH(S)-GRAD(S)
32    CONTINUE
      IF (TNOW.GE.TEND) THEN
         MSTOP=-1
      END IF
      RETURN
      END
```

```
C
C
      SUBROUTINE STATE
C
C
C     SUBROUTINE STATE CALCULATES THE VALUES OF THE
C     RATES, LEVELS AND AUXILIARIES FOR EACH TIME INCREMENT
C     (NOMINALLY, DTNOW).  STATE ALSO CONTROLS THE OPENING
C     AND CLOSING OF THE TECH SCHOOL GATE.
C
C
      INTEGER A,S
      REAL MCON(2),MOS(4,2),MROS(4,2),MRPROB(2),MPROB(2),LOSSES,
     +IMBALR(4,2),IMBALA(4,2)
      COMMON/SCOM1/ATRIB(100),DD(100),DDL(100),DTNOW,II,MFA,MSTOP,NCLNR
     +,NCRDR,NPRNT,NNRUN,NNSET,NTAPE,SS(100),SSL(100),TNEXT,TNOW,XX(100)
      COMMON/UCOM1/DNMAS(2),SPA(2),ISPA(2),IPA(4,2),DNPA(4,2),TEND
      DIMENSION AVTRL(4,2),AVTRLR(4,2),APROB(4,2),ARPROB(4,2),AROS(4,2),
     +ASMROS(4,2),ASAROS(4,2),ASMOS(4,2),ACON(4,2),AOS(4,2),ASAOS(4,2),
     +AVUPTM(2),DISFRM(2),DOS(4,2),DROS(4,2),DISCHM(2),PERCEL(2),D(4,2),
     +PA(4,2),PM(2),ROS(4,2),RNMAS(2),REMOS(4,2),REAOS(4,2),RROS(4,2),
     +REMROS(4,2),REAROS(4,2),SASMOS(2),SREMOS(2),SDOS(2),SACON(2),
     +SDROS(2),SMROS(2),TESCH(2),TOS(4,2),UPOM(2),UPIM(2),TROS(4,2),
     +SMOS(2),RATIO(4,2),SHORT(4,2),REQA(4,2),REQR(4,2),B(4,2),C(4,2),
     +TREQA(2),TREQR(2),RATR(4,2),RATA(4,2),DASMA(4,2),SIGMA(4,2),E(4,2)
     +,DASMR(4,2),SDASMA(2),SDASMR(2),ELIGA(2),ELIGR(2),SIGMR(4,2)
      EQUIVALENCE (SREMOS(1),XX(4)),(RNMAS(1),XX(6)),
     +(TRMAS,XX(8)),(STESCH,XX(9)),(TESCH(1),XX(10)),
     +(SASMOS(1),XX(12)),(PM(1),XX(14)),(PA(1,1),XX(16)),
     +(SMOS(1),XX(24)),(SMROS(1),XX(26)),(APROB(1,1),XX(28)),
     +(ARPROB(1,1),XX(36)),(MPROB(1),XX(44)),(MRPROB(1),XX(46)),
     +(ASMOS(1,1),XX(48)),(ASAOS(1,1),XX(56)),(ASMROS(1,1),XX(64)),
     +(ASAROS(1,1),XX(72)),
     +(MCON(1),SS(1)),(MOS(1,1),SS(3)),(ACON(1,1),SS(11)),
     +(AOS(1,1),SS(19)),(MROS(1,1),SS(27)),(AROS(1,1),SS(35))
C
```

```
C
      DATA ASMOS,ASMROS,ASAOS,ASAROS,PERCEL,ROS,RROS,REMOS,
     +REMROS,REAOS,REAROS,SACON,UPIM,UPOM,N/89*0.0/
      DATA AVUPTM/35.2,120./
      DATA DISFRM/.015,.015/
      DATA ((DOS(I,J),I=1,4),J=1,2)/779.,968.,69.,109.,313.,
     +369.,27.,46./
      DATA ((DROS(I,J),I=1,4),J=1,2)/135.,28.,0.,21.,45.,10.,1.,8./
      DATA ((TOS(I,J),I=1,4),J=1,2)/779.,968.,69.,109.,313.,
     +369.,27.,46./
      DATA ((TROS(I,J),I=1,4),J=1,2)/135.,28.,0.,21.,45.,10.,1.,8./
      DATA ((AVTRL(I,J),I=1,4),J=1,2)/33.32,34.15,31.9,34.04,38.7,
     +39.5,37.4,37.9/
      DATA ((AVTRLR(I,J),I=1,4),J=1,2)/15.2,11.97,999.,12.06,14.54,
     +13.2,12.0,12.0/
      DATA SDROS/184.,64./
      DATA SDOS/1925.,755./
      DATA((SIGMA(I,J),I=1,4),J=1,2)/.54,.48,1.79,.93,.86,
     +.84,2.48,1.26/
      DATA((SIGMR(I,J),I=1,4),J=1,2)/.89,.12,1.,.06,1.30,
     +1.2,.5,.22/
C
C     -----------------
C     AUXILIARY EQUATIONS
C     -----------------
C
C     RATIO IS THE BASIS FOR REINSERTING LOSSES INTO THE
C     ORIGINAL AFSCS. THE LOSSES ARE FOR ALL REASONS SUCH AS
C     CROSS-TRAINING, DISCHARGE, OR RETIREMENT.  RROS AND
C     ROS SIMPLY DEFINE THE CURRENT REQUIREMENT FOR PER-
C     SONNEL IN REMOTE AND ACCOMPANIED TOURS.
C
C
```

```
      TOTSHO=0.
      DO 10 S=1,2
         SPA(S)=PA(1,S)+PA(2,S)+PA(3,S)+PA(4,S)
         SACON(S)=ACON(1,S)+ACON(2,S)+ACON(3,S)+ACON(4,S)
         DO 20 A=1,4
         SHORT(A,S)=DNPA(A,S)-PA(A,S)
         IF (SHORT(A,S).LT.0.) THEN
            SHORT(A,S)=0.
         END IF
         TOTSHO=TOTSHO + SHORT(A,S)
         IF (TOTSHO.GT.0.) THEN
            RATIO(A,S)=SHORT(A,S)/TOTSHO
         ELSE
           RATIO(A,S)=IPA(A,S)/(ISPA(1) + ISPA(2))
         END IF
            RROS(A,S)=DROS(A,S)-TROS(A,S)
            ROS(A,S)=DOS(A,S)-TOS(A,S)
20       CONTINUE
10    CONTINUE
      DO 23 S=1,2
C
C
C     INITIALIZE THE MEAN AND STANDARD DEV OF THE
C     PROBABILITY DISTRIBUTIONS ON TOUR LENGTH.
C
C
         DO 24 A=1,4
           E(A,S)=AVTRL(A,S)
           B(A,S)=AVTRLR(A,S)
           C(A,S)=SIGMA(A,S)
           D(A,S)=SIGMR(A,S)
24       CONTINUE
23    CONTINUE
C
```

```
C     DEFINES THE PERCENTAGE OF TOTAL ASSIGNMENTS TO BE
C     FILLED BY THE MASTER AFSC.
C
      DO 25 S=1,2
         PERCEL(S)=MCON(S)/(SACON(S)+MCON(S))
25    CONTINUE
C
C
C     --------------
C     RATE EQUATIONS
C     --------------
C
C
C     UPGRADE/DISCHARGE LOSSES
      DISCHM(1)=PM(1)*RNORM(.0158,.0018,1)
      DISCHM(2)=PM(2)*RNORM(.0154,.001,2)
      UPOM(1)=DISCHM(2)
      UPOM(2)=0.
      UPIM(1)=0.
      UPIM(2)=UPOM(1)
      IF (PM(2).GE.DNMAS(2)) THEN
         UPIM(2)=0.
         UPOM(1)=0.
      END IF
C
C
C     ASSIGNMENT RATES&PROBABILITIES
C
C     THIS SYSTEM IS DRIVEN BY OSEAS RETURNEES.  RETURNEES
C     ALONG WITH CURRENT REQUIREMENTS DEFINE THE NUMBER OF
C     ASSIGNMENTS TO BE MADE.  REQA AND REQR ARE ESSENTIALLY
C     THE VACANCIES CAUSED BY PROJECTED RETURNS PLUS
C     CURRENT SHORTFALLS.
C
```

```
C
      DO 30 S=1,2
         DO 40 A=1,4
            REAROS(A,S)=AROS(A,S)/RNORM(B(A,S),D(A,S),3)
            REAOS(A,S)=AOS(A,S)/RNORM(E(A,S),C(A,S),4)
            REMOS(A,S)=MOS(A,S)/RNORM(E(A,S),C(A,S),5)
            REMROS(A,S)=MROS(A,S)/RNORM(B(A,S),D(A,S),6)
40       CONTINUE
30    CONTINUE
C
      DO 31 S=1,2
         DO 41 A=1,4
            REQA(A,S)=ROS(A,S)+REMOS(A,S)+REAOS(A,S)
            REQR(A,S)=RROS(A,S)+REMROS(A,S)+REAROS(A,S)
            IF (REQA(A,S).LT.0.) THEN
               REQA(A,S)=0.
            END IF
            IF (REQR(A,S).LT.0.) THEN
               REQR(A,S)=0.
            END IF
41       CONTINUE
31    CONTINUE
C
C
C     RATA/RATR ARE MONTHLY MEASURES OF THE IMBALANCE IN
C     REQUIREMENTS OVERSEAS TO CONUS MANPOWER.
C
      DO 32 S=1,2
      TREQR(S)=REQR(1,S)+REQR(2,S)+REQR(3,S)+REQR(4,S)
      TREQA(S)=REQA(1,S)+REQA(2,S)+REQA(3,S)+REQA(4,S)
         DO 42 A=1,4
            RATR(A,S)=REQR(A,S)/ACON(A,S)
            RATA(A,S)=REQA(A,S)/ACON(A,S)
42    CONTINUE
32    CONTINUE
C
```

```
C
C     IMBALA/IMBALR NORMALIZE THE IMBALANCE MEASURES OF
C     RATA/RATR.  THEY SHOW THE RELATIVE IMBALANCE OF
C     THE CAREER FIELDS AT BOTH SKILL LEVELS.
C     DASMA/DASMR ALLOCATE DESIRED ASSIGNMENTS FROM THE
C     MASTER AFSC BASED ON THE DEGREE OF IMBALANCE.
C
      DO 33 S=1,2
         DO 43 A=1,4
            IMBALR(A,S)=RATR(A,S)/(RATR(1,S)+RATR(2,S)+RATR(3,S)+
     +                RATR(4,S))
            IMBALA(A,S)=RATA(A,S)/(RATA(1,S)+RATA(2,S)+RATA(3,S)+
     +               RATA(4,S))
            DASMA(A,S)=IMBALA(A,S)*REQA(A,S)
            DASMR(A,S)=IMBALR(A,S)*REQR(A,S)
43       CONTINUE
33    CONTINUE
C
C
C     ALLOCATES THE ASSISTANCE FROM THE MASTER AFSC WHEN
C     CONSTRAINED BY MANPOWER AVAILABILITY(PERCEL) AND
C     TOTAL REQUIREMENTS (TREQA/TREQR).
C
      DO 34 S=1,2
         SDASMA(S)=DASMA(1,S)+DASMA(2,S)+DASMA(3,S)+DASMA(4,S)
         SDASMR(S)=DASMR(1,S)+DASMR(2,S)+DASMR(3,S)+DASMR(4,S)
         ELIGA(S)=PERCEL(S)*TREQA(S)
         ELIGR(S)=PERCEL(S)*TREQR(S)
C
C
C     ASMOS/ASMROS ARE THE NUMBER OF MASTER AFSC PERSONNEL
C     ASSIGNED OSEAS IN A GIVEN MONTH BASED ON THE ABOVE
C     FACTORS
C
```

```
          DO 44 A=1,4
             ASMOS(A,S)=(DASMA(A,S)/SDASMA(S))*ELIGA(S)
             ASMROS(A,S)=(DASMR(A,S)/SDASMR(S))*ELIGR(S)
           IF (ASMOS(A,S).GT.REQA(A,S)) THEN
                ASMOS(A,S)=REQA(A,S)
           END IF
           IF (ASMROS(A,S).GT.REQR(A,S)) THEN
                ASMROS(A,S)=REQR(A,S)
           END IF
C
C
C      ASAOS/ASAROS ARE THE NUMBER OF ASIGNMENTS IN A GIVEN
C      MONTH THAT ARE FILLED BY THE ORIGINAL AFSCS
C
C
             ASAOS(A,S)=REQA(A,S)-ASMOS(A,S)
             ASAROS(A,S)=REQR(A,S)-ASMROS(A,S)
             APROB(A,S)=ASAOS(A,S)/ACON(A,S)
             ARPROB(A,S)=ASAROS(A,S)/ACON(A,S)
             IF(MCON(S).GT.0.)THEN
                MPROB(S)=(ASMOS(1,S)+ASMOS(2,S)+ASMOS(3,S)+
     +                   ASMOS(4,S))/MCON(S)
                MRPROB(S)=(ASMROS(1,S)+ASMROS(2,S)+ASMROS(3,S)+
     +                   ASMROS(4,S))/MCON(S)
            END IF
44        CONTINUE
34     CONTINUE
       LOSSES=DISCHM(1)+DISCHM(2)+UPOM(2)
C
C      SUM OF THE RATES
       DO 70 S=1,2
       SREMOS(S)=REMOS(1,S)+REMOS(2,S)+REMOS(3,S)+REMOS(4,S)+
     +       REMROS(1,S)+REMROS(2,S)+REMROS(3,S)+REMROS(4,S)
       SASMOS(S)=ASMOS(1,S)+ASMOS(2,S)+ASMOS(3,S)+ASMOS(4,S)+
     +          ASMROS(1,S)+ASMROS(2,S)+ASMROS(3,S)+ASMROS(4,S)
70     CONTINUE
```

```
C
C
C     ---------------
C     LEVEL EQUATIONS
C     ---------------
C
C
C     SIMPLY UPDATE THE NUMBER OF PERSONEL REMOTE ACCOMPANIED
C     AND IN CONUS, BASED ON THE RATES OF THE PREVIOUS PERIOD
C
C
      DO 80 S=1,2
      IF(PM(S).GT.0.)THEN
      MCON(S)=MCON(S) + DTNOW*(SREMOS(S)-SASMOS(S)-DISCHM(S)
     +          +(UPIM(S)-UPOM(S))*(MCON(S)/PM(S)))
      END IF
         DO 90 A=1,4
            AOS(A,S)=AOS(A,S) + DTNOW*(ASAOS(A,S)-REAOS(A,S))
            AROS(A,S)=AROS(A,S) + DTNOW*(ASAROS(A,S)-REAROS(A,S))
            ACON(A,S)=ACON(A,S) + DTNOW*(REAOS(A,S) + REAROS(A,S)-
     +                  ASAOS(A,S) - ASAROS(A,S) +RATIO(A,S)*LOSSES)
      IF(PM(S).GT.0.)THEN
            MOS(A,S)=MOS(A,S) + DTNOW*(ASMOS(A,S)-REMOS(A,S)+
     +                 (UPIM(S)-UPOM(S))*(MOS(A,S)/PM(S)))
            MROS(A,S)=MROS(A,S) + DTNOW*(ASMROS(A,S)-REMROS(A,S)+
     +                  (UPIM(S)-UPOM(S))*(MROS(A,S)/PM(S)))
      END IF
            TOS(A,S)=AOS(A,S)+MOS(A,S)
            TROS(A,S)=AROS(A,S)+MROS(A,S)
90       CONTINUE
80    CONTINUE
C
C
```

```
C     ------------------
C     AUXILIARY EQUATIONS
C     ------------------
C
C
      DO 100 S=1,2
         SMOS(S)=MOS(1,S)+MOS(2,S)+MOS(3,S)+MOS(4,S)
         SMROS(S)=MROS(1,S)+MROS(2,S)+MROS(3,S)+MROS(4,S)
         PM(S)=MCON(S)+SMOS(S)+SMROS(S)
         RNMAS(S)=DNMAS(S)-PM(S)
         IF (RNMAS(S).LT.0.) THEN
            RNMAS(S)=0.
         END IF
         XX(S)=RNMAS(S)-TESCH(S)
         DO 101 A=1,4
            PA(A,S)=ACON(A,S)+AOS(A,S)+AROS(A,S)
101      CONTINUE
100   CONTINUE
      TRMAS=RNMAS(1)+RNMAS(2)
      STESCH=TESCH(1)+TESCH(2)
      XX(3)=TRMAS-STESCH
```

```
C
C     ----------------------
C     CHECK FOR SCHOOL RQMTS
C     ----------------------
C
C     CONTROLS OPERATION OF THE TECH SCHOOL. CHANGES THE STATUS
C     OF THE GATE WHICH OPENS TO ALLOW CLASSES TO START.  CLOSING
C     THE GATE DOES NOT SHUT DOWN THE SCHOOL, IT MERELY PREVENTS
C     NEW CLASSES FROM STARTING. CURRENT CLASSES CONTINUE.
C
C
      IF((XX(1).GT.20.).OR.(XX(2).GT.20.).OR.(XX(3).GT.20.)) THEN
         IF (NNGAT(1).EQ.1) THEN
            CALL OPEN(1)
         END IF
      END IF
      IF (TNOW.GE.6.0) THEN
      IF((XX(1).LE.20.).AND.(XX(2).LE.20.).AND.(XX(3).LE.20.))THEN
         IF (NNGAT(1).EQ.0) THEN
            CALL CLOSX(1)
            N=N+1
            IF (N.EQ.1) THEN
               CALL CLEAR
               TEND=TNOW+50.
            END IF
         END IF
      END IF
      END IF
      RETURN
      END
```

```
GEN,LITTRA,THESIS,7/1/82,5;
LIMITS,2,8,20;
TIMST,XX(28),APROB11;
TIMST,XX(29),APROB21;
TIMST,XX(30),APROB31;
TIMST,XX(31),APROB41;
TIMST,XX(32),APROB12;
TIMST,XX(33),APROB22;
TIMST,XX(34),APROB32;
TIMST,XX(35),APROB42;
TIMST,XX(36),ARPROB11;
TIMST,XX(37),ARPROB21;
TIMST,XX(38),ARPROB31;
TIMST,XX(39),ARPROB31;
TIMST,XX(40),ARPROB12;
TIMST,XX(41),ARPROB22;
TIMST,XX(42),ARPROB32;
TIMST,XX(43),ARPROB42;
TIMST,XX(44),MPROB1;
TIMST,XX(45),MPROB2;
TIMST,XX(46),MRPROB1;
TIMST,XX(47),MRPROB2;
CONTINUOUS,0,42,.01,1,1;
SEEDS,26575(1)/YES,08625(2)/YES,40801(3)/YES,
      65424(4)/YES,82271(5)/YES,18912(6)/YES;
;
;
;
NETWORK;
;------
;
;  SIMULATION CONTROL NETWORK
;  -------------------------
      RESOURCE/CLSS(6),2;  6 AVAILABLE CLASSES
      GATE/SCHL,OPEN,1;    REQUIREMENTS GATE
      CREATE,,0,,1,1;
      ACT/1,5;             VALIDATE ORIGINAL SYSTEM
      EVENT,1,1;           MODIFY SYSTEM-DEFINE MASTER RQMTS
      ACT/2;
BEGN  AWAIT(1),SCHL,1;     WAIT FOR SCHOOL TO OPEN
      ACT/3;
      AWAIT(2),CLSS/1,1;   WAIT FOR AVAILABLE CLASS
      ACT/4;
      EVENT,2,1;           SEL(A,S) ASSGND AS ATTRIBUTES
      ACT/5,.50;           TIME BETWEEN CLASS STARTS
      GOON,2;
      ACT/6,3.25,,GRAD;    REMAINDER OF SCHOOL
      ACT/7,,,BEGN;
GRAD  FREE,CLSS/1,1;       MAKE CLASS AVAILABLE
      ACT/8;
      EVENT,3,1;           ATTRIBUTES READ HERE
      TERM;
;
      END;
;
;
INITIALIZE,0,120;
MONTR,TRACE,100,120,1,2,5,6;
SIMULATE;
SEEDS,00582(1)/YES,04711(2)/YES,87917(3)/YES,35126(4)/YES,
       82271(5)/YES,18912(6)/YES;
SIMULATE;
SEEDS,74087(1)/YES,99547(2)/YES,81817(3)/YES,04637(4)/YES,
       36086(5)/YES,76222(6)/YES;
SIMULATE;
SEEDS,88072(1)/YES,86324(2)/YES,56170(3)/YES,62797(4)/YES,
       69884(5)/YES,00725(6)/YES;
SIMULATE;
SEEDS,69011(1)/YES,65795(2)/YES,95876(3)/YES,55293(4)/YES,
      18988(5)/YES,27354(6)/YES;
FIN;
```

APPENDIX D

MCINTYRE (DPMDW) ROTATION MODEL

The McIntyre (DPMDW) Rotation Model discussion which follows is extracted from a 4 Aug 1976, "Memo for Users of DPMDW Rotation Model", subject: Understanding and Using the Model (1).

The rotation base model presents three independent views of the inherent balance in the manpower structure as related to personnel policy. The first, and most sophisticated, analysis is a steady-state network to assess the balance in terms of minimum time between oversea assignments. The parameters which describe the network are: (1) time in months between oversea tours, (2) travel time in days between CONUS and oversea locations, and (3) a first assignment restriction in months (applied to 3-levels only; basically holds all accessions in CONUS for a specified period before they enter the main network). Additional data, derived from other systems or files and not variable are: (1) the authorizations themselves, (2) loss rates, (3) average tour lengths, and (4) strengths which are printed for comparison purposes but which have no algebraic bearing on the model results. A diagram of this network is given below:

DELAYS IN THE NETWORK:

a = first assignment restriction

b = time between O/S tours

c = travel time

d = average O/S tour length

Owing to the nature of this approach, the network is used to assess the balance by skill level only (first for AFSC ladders, then for the CPG using cumulative authorizations and average skill level loss rates). The total (X-level) lines are simply the arithmetic sum of the pertinent skill level results.

The second assessment is a simplistic formula to derive the minimum CONUS base to support a policy of requiring airmen to serve no longer than a specified number of years overseas in a "career" of stated length. Current policy states a maximum of 8 years overseas in a 20 year "career". The mathematical "model" is given below:

Let B = CONUS base
R = oversea requirement
T = length of career in years
t = maximum allowable years overseas in a career of length T

Then: $$B = \frac{T}{t} \cdot R - R$$

Thus for current policy,

$$B = \frac{20}{8} \cdot R - R = 1.5R$$

The final assessment is tailored to derive the minimum rotation base to support a policy of requiring airmen to serve no more than a given number of remote tours (length 1 year each) in a career. The model is given below:

Let B = CONUS base
R = oversea requirement
r = remote requirement
T = career length in years
n = maximum number of remote tours in a career of length T

Then: $$B = \frac{T}{n} \cdot r - R$$

Current policy restricts the ideal solution to <u>two</u> tours in a <u>20</u> year career. Thus:

$$B = \frac{20}{2} \cdot r - R = 10 \cdot r - R$$

If R is greater than T/n times r, B goes negative indicating that remote authorizations can be supported entirely by oversea slots.

APPENDIX E

OPINION QUESTIONNAIRE

To evaluate how successful we have been in modeling the 304XX overseas rotation problem, please share your opinions on the following questions.

In your opinion:

1. Do you feel that the attached structural model of the AFSC consolidation is a useful representation of the problem?

Questionnaire One: No response.

Questionnaire Two: Yes. The differences between the two categories of "CONUS personnel" should be more fully explained in the briefing.

Questionnaire Three: Basically yes, however, it is not entirely clear because of inconsistent graphical presentation. The Consolidated AFSC box should look like the other AFSC levels . Also, it appears that AFSC 304XC (my notation for your new AFSC) personnel will be assigned to overseas 304X0, X4, X5, or X6 slots, while in the CONUS, they remain in some differently shown 304XC slots rather than XO, X4, X5, or X6. You showed a 304XC level for CONUS but not O/S. You use people out of all AFSC levels. Asmts are <u>to</u> tech school from the field (both CONUS & O/S although you probably said CONUS only implying no one should be pulled out of O/S for school), ans asmts are from tech school to either a CONUS or O/S pool of 304XCs. I'm still not sure if you would have authorizations remain as they are but permit a fill by either the specific AFSC or the 304Xc, or if you would convert some slots to 304XC. It is probably the former.

2. Do the ideas of assignment flow rates and probabilities seem to be validly used in the model?

Questionnaire One: No response.

Questionnaire Two: Yes, but unfortunately, it points out too vividly that things will get worse for the 304X0s (assignment-wise) for several years after the merger, and may make the program harder to sell.

Questionnaire Three: Yes. You probably could factor in a failure rate or whashout rate from the tech school with some getting out of service and some going back to their old AFSC.

3. The model predicts improvements in URIs due to a consolidation of AFSCs. Does this prediction seem realistic?

Questionnaire One: No response.

Questionnaire Two: Yes; that's the general idea!

Questionnaire Three: Yes. The problem with consolidations/mergers is not one of assignment method but is instead a problem with job proficiency, testing and promotion equity, training expenditures and their payback. That is why they haven't taken place before now.

4. What other research would you like to see in this area?

Questionnaire One: The basic training new received in each career field and to what extent it would have to be increased to provide qualified personnel to the consolidated school.

Questionnaire Two: Run the model considering that all of the slots in the affected AFSCs will be consolidated, not just an arbitrary percentage.

Questionnaire Three: Recommend an effort to develop a SLAM model which can be compared in various ways to CAROM and even McIntyre. This could pave the way for an upgrade of the Air Force modeling language for career field management.

5. Please give us any additional comments or opinions you feel would be constructive or useful in this area.

Questionnaire One: Recommend a new AFSC be established after consolidation with upgrade skill level requirements.

Questionnaire Two: From the thesis advisor's point of view - I think he'll want to see some sensitivity effects - what happens when you change your assumptions.

Questionnaire Three: Clear up the distinction between watching <u>people</u> and watching <u>positions</u>. 100% manning assumptions can skew your results away from reality. It's manning, not authorizations that perform the mission.

OPINION

QUESTIONAIRE

To evaluate how successful we have been in modeling the 304XX overseas rotation problem, please share your opinions on the following questions.

In your opinion:

1. Do you feel that the attached structural model of the AFSC consolidation is a useful representation of the problem?

YES

2. Do the ideas of assignment flow rates and probabilities seem to be validly used in the model?

YES

3. The model predicts improvements in URIs due to a consolidation of AFSCs. Does this prediction seem realistic?

Realistic yes, but Probability is questioned: the vagarities of the Assignment pocess must be eliminated to provide for a firm process. The SEI system could be made a firm criteria for Assigmment consideration, but that would open the door for more Congressionals than we (USAF) now have, because of the Base of preferance/"dream-sheet" aspects of the assignment system.

4. What other research would you like to see in this area?

5. Please give us any additional comments or opinions you feel would be constructive or useful in this area.

The study ought to be redone in about 6-9 months, to consider and emphasize on the graduates of the Navy school, now the trial program that AFCC/CC has initiated. (The intent is to learn what trade-off we might hit in terms of URI/re-enlistee/stronger training in Basic electronics and greater flexibility in AFSC-based assignments.)

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